Agilent Technologies 87050A Option K22

Multiport Test Set

Agilent Technologies 87050A Option K22

Multiport Test Set

User's and Service Guide

Agilent Technologies

Manufacturing Part Number: 87050-90105

Printed in USA: November 2009
Supersede July 2007

© Copyright Agilent Technologies, Inc. 2007, 2009

Warranty Statement

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED “AS IS,” AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, AGILENT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. AGILENT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD AGILENT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

DFARS/Restricted Rights Notice

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as “Commercial computer software” as defined in DFAR 252.227-7014 (June 1995), or as a “commercial item” as defined in FAR 2.101(a) or as “Restricted computer software” as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies’ standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notes

The following safety notes are used throughout this document. Familiarize yourself with each of these notes and its meaning before performing any of the procedures in this document.

WARNING	**Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**

CAUTION	Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

Definitions

- *Specifications* describe the performance of parameters covered by the product warranty (temperature –0 to 55 °C, unless otherwise noted.)
- *Typical* describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- *Nominal* values indicate expected performance or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- *Characteristic Performance* describes performance parameter that the product is expected to meet before it leaves the factory, but is not verified in the field and is not covered by the product warranty. A characteristic includes the same guard bands as a specification.

Contents

87050A Option K22

Description . . . 2
Verifying the Shipment . . . 2
Meeting Electrical and Environmental Requirements . . . 3
Electrical . . . 3
Environmental . . . 3
Operating Environment . . . 3
Weight . . . 3
Cabinet Dimensions . . . 3
Agilent 87050A Option K22 Options . . . 4
UK6 . . . 4
Rack Ear Mounts . . . 4
Preparations . . . 5
Electrostatic Discharge Protection . . . 7
Getting Started . . . 8
Connecting and Turning on the Test Set . . . 8
Setting the Test Set Address Switch . . . 9
Performing the Operator's Check . . . 10
Equipment Required . . . 10
Process . . . 10
Controlling the Test Set and Making Measurements . . . 11
Typeface Key Conventions . . . 11
Commands . . . 12
Computer Control . . . 12
Network Analyzer Control . . . 14
Calibrating the Test System . . . 24
Making Measurements . . . 25
Measuring Transmission . . . 25
Measuring Reflection . . . 25
Example Programs . . . 26
The "CONTROL" Program . . . 26
Front Panel . . . 43
Rear Panel . . . 45
Specifications . . . 47
Performance Tests . . . 48
Insertion Loss . . . 49
Return Loss . . . 49
Isolation . . . 50
Performance Test Record . . . 51
Adjustments . . . 59
Assembly Replacement and Post-Repair Procedures . . . 60
Troubleshooting and Block Diagram . . . 63
General Troubleshooting Notes . . . 63
Power Supply Problems . . . 63
Front Panel Board . . . 64
Controller and Switch Driver Boards . . . 64
Theory of Operation . . . 66
System Theory . . . 66
A1 Power Supply Theory . . . 66
A2 Front Panel Display Theory . . . 66
A3 Controller (Mother Board) and Switch Driver (Daughter Board) Board Theory . . . 66
Connector Replacement . . . 67

Contents

Safety and Regulatory Information 68
Introduction 68
Before Applying Power 68
Connector Care and Cleaning 68
Declaration of Conformity 68
Statement of Compliance 68
General Safety Considerations 69
Cautions 69
Warnings 70
Regulatory Information 71
Instrument Markings 71
Battery Collection 72
Compliance with German Noise Requirements 72
EMC Information 72
Electrostatic Discharge Protection 73
Agilent Support, Services, and Assistance 74
Service and Support Options 74
Contacting Agilent 74
Shipping Your Analyzer to Agilent for Service or Repair 74

87050A Option K22

Description

The Agilent 87050A Option K22 Multiport Test Set is designed for use with 50 Ω Network Analyzers, such as the Agilent 8719D/ES, 8720D/ES, and 8722D/ES.

The test set provides single connection, multiple measurements of multiport devices with up to twelve ports, such as distribution amplifiers, taps, switches and couplers. Throughput is increased by reducing the number of device reconnects the operator must perform. Switching is performed with mechanical switches.

The test set can be controlled by using an external GPIB controller or parallel control.

This document will guide you through the steps necessary to correctly and safely install your multiport test set.

NOTE This User's and Service Guide documents the use of the test set with an Agilent 8720D only.

Verifying the Shipment

Verify the items received in Table 1.

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to "Agilent Support, Services, and Assistance" on page 74. Keep the damaged shipping materials (if any) for inspection by the carrier and an Agilent Technologies representative.

Table 1 87050A Option K22 Accessories Supplied

Description	Agilent Part Number	Quantity
Power Cord	See Figure 3 on page 6	1
Front Handle Kit	5063-9228	1
Rack Mount Kit	5063-9235	1
Parallel Port Interface Cable	8120-6818	1
RF Cable 8720D (without feet) to A i/p 2 or B i/p 2	08720-20245	2
RF Cable, Option K22 Aux 1/2 to Option K12	08720-20246	2
User's and Service Guide	87050-90105	1

Meeting Electrical and Environmental Requirements

Electrical

The line power module on your test set is an autoranging input.

CAUTION This product has an autoranging line voltage input. Be sure the supply voltage is within the specified range. If the ac line voltage does not fall within these ranges, an autotransformer that provides third wire continuity to earth ground should be used.

Ensure that the available ac power source meets the following requirements:

- 100/120/220/240 Vac
- 50/60 Hz
- 40 Watts

Environmental

Operating Environment

Indoor use only

Operating Temperature: 0 to 55 °C

Storage Temperature: –40 °C to +70 °C

Altitude: 10,000 feet (3,000 meters)

Enclosure Protection IP 2 0

Weight

Net: Approximately 9 kg

Shipping: Approximately 20 kg

CAUTION This product is designed for use in Installation Category II, and Pollution Degree 2.

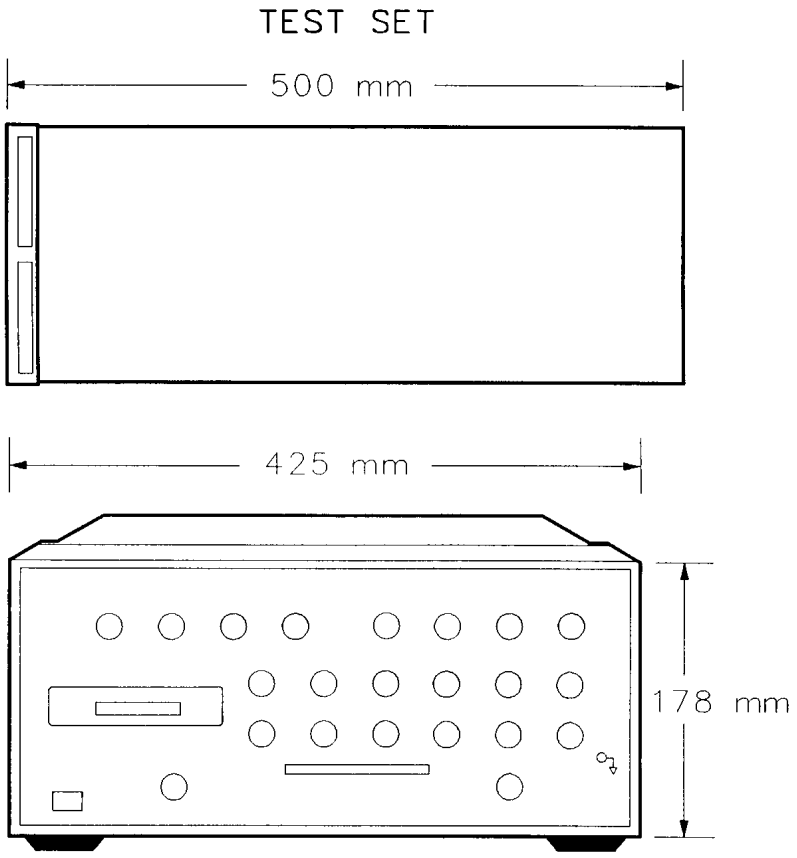
Cabinet Dimensions

These dimensions exclude front and rear panel protrusions.

178 mm H x 425 mm W x 500 mm D

(7.02 in x 16.75 in x 19.7 in)

Figure 1 Agilent 87050A Option K22 Physical Dimensions



Agilent 87050A Option K22 Options

UK6

Option UK6 provides a commercial calibration certificate including actual test data. Data includes test results of 115 tests including reflection, transmission, and isolation from A i/p to B i/p to all test ports.

Rack Ear Mounts

Option 908, part number 5062-3974, provides rack mounts that make it quick and easy to install or remove the test set from a main frame.

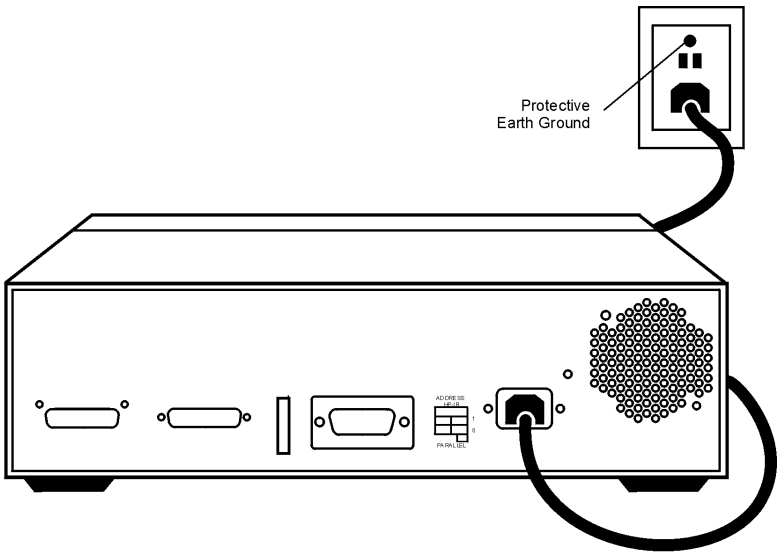
For further information on these options please contact the nearest Agilent Technologies sales or service office. Refer to "Contacting Agilent" on page 74.

Preparations

1. Ensure that the "Meeting Electrical and Environmental Requirements" on page 3 are met.
2. Verify that the power cable is not damaged, and that the power source outlet provides a protective earth ground contact. Note that the Figure 2 depicts only one type of power source outlet. Refer to Figure 3 on page 6 to see the different types of power cord plugs that can be used with your test set. Cables are available in different lengths. For descriptions and part numbers of cables other than those described in Figure 3, Refer to "Contacting Agilent" on page 74.
3. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

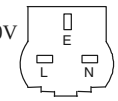
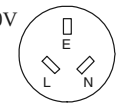
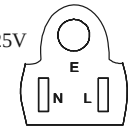
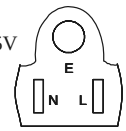
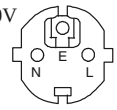
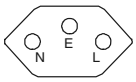
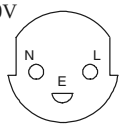
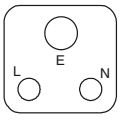
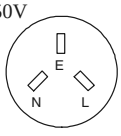
WARNING **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption of the protective conductor is prohibited.**

Figure 2 Protective Earth Ground



CAUTION Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

Figure 3 Power Cables

Plug Type [a]	Cable Part Number	Plug [b] Description	Length cm (in.)	Cable Color	For Use in Country
250V 	8120-8705 8120-8709	Straight BS 1363A 90˚	229 (90) 229 (90)	Mint Gray Mint Gray	Option 900 United Kingdom, Hong Kong, Cyprus, Nigeria, Singapore, Zimbabwe
250V 	8120-1369 8120-0696	Straight AS 3112 90˚	210 (79) 200 (78)	Gray Gray	Option 901 Argentina, Australia, New Zealand, Mainland China
125V 	8120-1378 8120-1521	Straight NEMA 5-15P 90˚	203 (80) 203 (80)	Jade Gray Jade Gray	Option 903 United States, Canada, Brazil, Colombia, Mexico,Philippines, Saudi Arabia, Taiwan
125V 	8120-4753 8120-4754	Straight NEMA 5-15P 90˚	229 (90) 229 (90)	Gray Gray	Option 918 Japan
250V 	8120-1689 8120-1692	Straight CEE 7/VII 90˚	200 (78) 200 (78)	Mint Gray Mint Gray	Option 902 Continental Europe, Central African Republic, United Arab Republic
230V 	8120-2104 8120-2296	Straight SEV Type 12 90˚	200 (78) 200 (78)	Gray Gray	Option 906 Switzerland
220V 	8120-2956 8120-2957	Straight SR 107-2-D 90˚	200 (78) 200 (78)	Gray Gray	Option 912 Denmark
250V 	8120-4211 8120-4600	Straight IEC 83-B1 90˚	200 (78) 200 (78)	Mint Gray Mint Gray	Option 917 South Africa, India
250V 	8120-5182 8120-5181	Straight SI 32 90˚	200 (78) 200 (78)	Jade Gray Jade Gray	Option 919 Israel

a. E =earth ground, L = line, and N = neutral.
b. Plug identifier numbers describe the plug only. The Agilent Technologies part number is for the complete cable assembly.

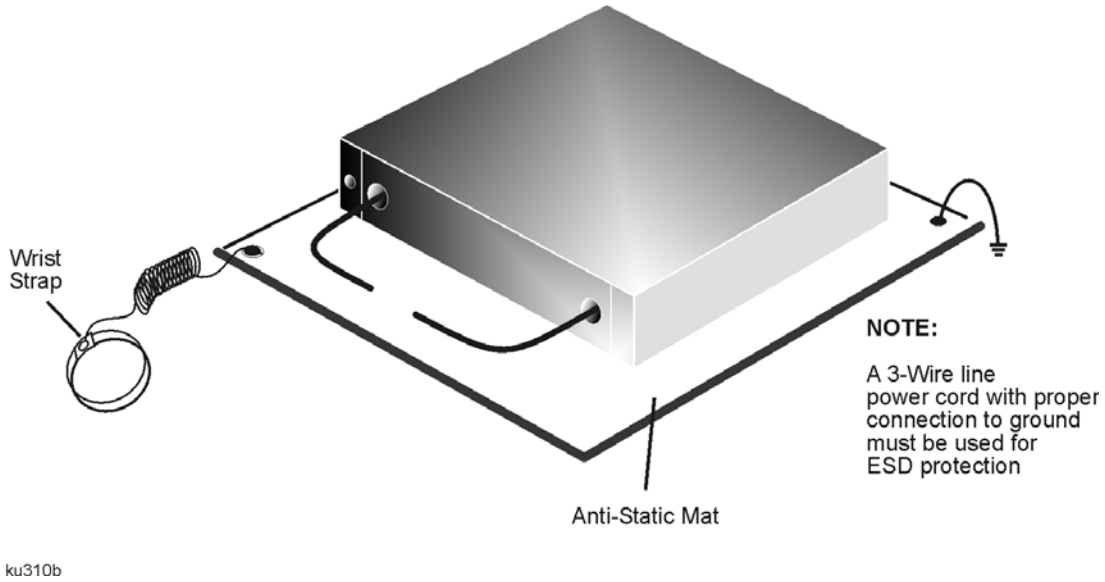
Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the network analyzer. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat (9300-0797) in front of your test equipment.
- *always* wear a grounded wrist strap (9300-1367) with grounding cord (9300-0980), connected to a grounded conductive table mat, having a 1 MW resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap (9300-1126) when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:

  1. Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.
  2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
  3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 4 ESD Protection Setup

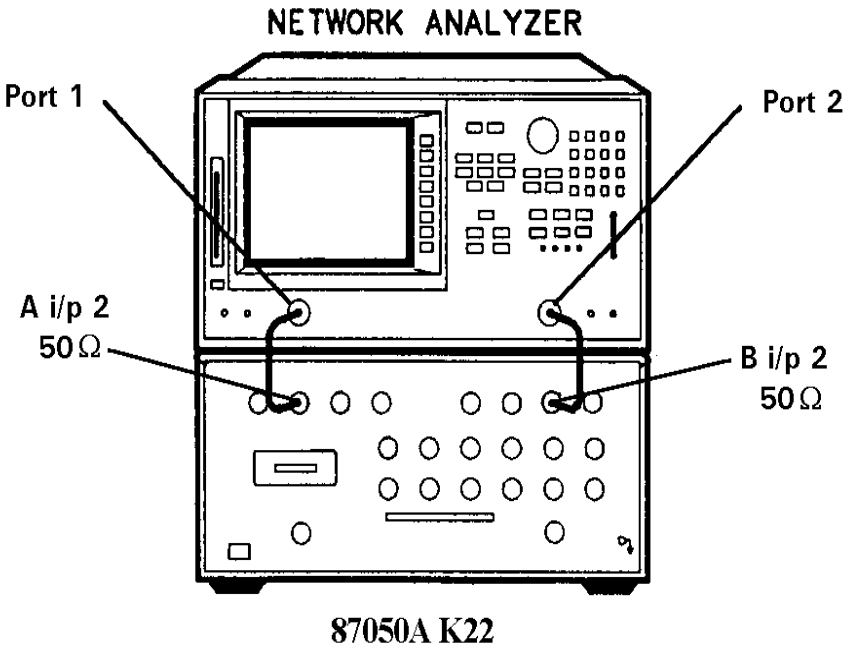


Getting Started

Connecting and Turning on the Test Set

The test set is designed to be placed underneath the network ana6lyzer in a rack system and connected to it as shown in Figure 5. Use the two SMA 50 Ω jumper cables (08720-20245) that were shipped with the test set. See Table 1 on page 2.

Figure 5 Connecting the Test Set to the Network Analyzer



After all the proper connections have been made, turn on the test set using the front panel line switch. Refer to Figure 12 on page 43.

NOTE For accurate, repeatable measurements, be sure to let the test set warm up for at least 2 hours. It is recommended that the test set not be turned off on a regular basis. For the most stable and accurate measurements, leave the test set turned on at all times.

Setting the Test Set Address Switch

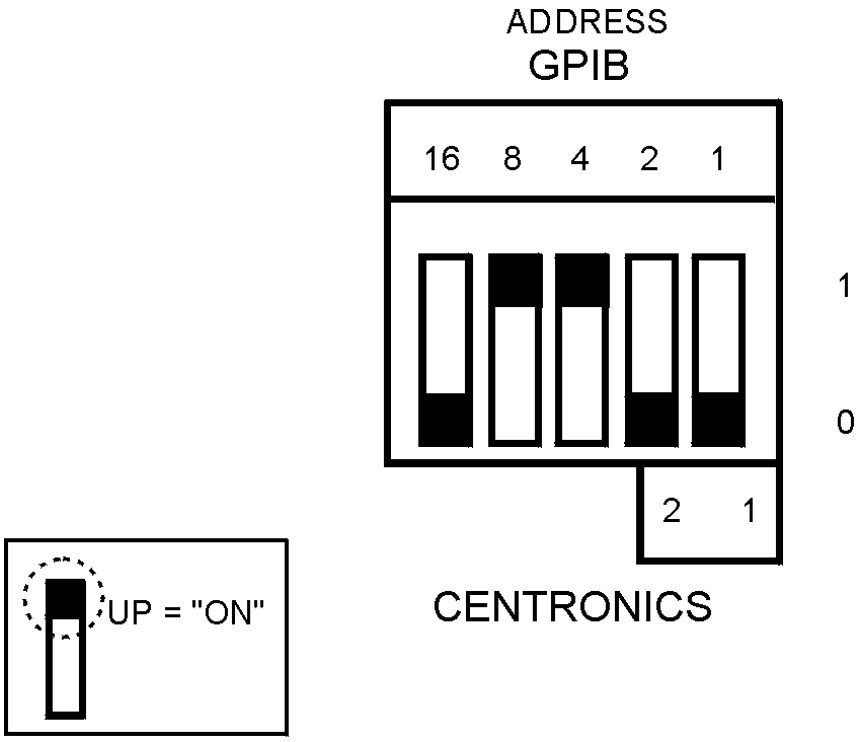
The test set is shipped with the GPIB address set to 12, which sets the parallel address to 00 as in Figure 6. Refer to "Controlling the Test Set and Making Measurements" on page 11 for the definition of the parallel address.

To set the GPIB address, set all five switches so that the sum of the switches in the “on” or “1” position equal the desired address. In the example below, the two switches in the “on” position are 8 and 4, thus the GPIB address of 12.

To set the parallel address, use only the number 1 switch. Therefore the possibilities for parallel port addressing are an address of 0 or 1.

When GPIB is used, the parallel address is ignored.

Figure 6 The Test Set Address Switch



Performing the Operator's Check

For information on how to control the test set, refer to "Controlling the Test Set and Making Measurements" on page 11.

The following operator's check is designed to provide you with a high degree of confidence that your test set is working properly. It is not designed to verify specifications. To verify specifications, refer to "Performance Tests" on page 48.

This procedure is for performing a simple operator's check using a network analyzer of the proper frequency range and impedance.

Equipment Required

- Network Analyzer, 50 Ω impedance (Agilent 8720D)
- Computer (HP 9000 series 200/300/700)
- "The "CONTROL" Program". See "Example Programs" on page 26.
- Cable, 50 Ω 3.5 mm (part number 85131-60012 or equivalent)
- Calibration Kit, 50 Ω (part number 85052B)

Process

Step 1. Perform a one-port reflection calibration at the end of a 50 Ω cable over the frequency range of 50 MHz to 20 GHz on the analyzer. Verify the calibration is active and that the shorted cable displays a return loss of 0 ±0.2 dB.

Step 2. Connect the cable (already connected to the reflection port of the analyzer) to the reflection port of the 87050A Option K22.

Step 3. Measure the return loss of each section of the test set by selecting ports 1 through 12, one at a time, by using the "Control" program and viewing the display on the analyzer. Terminate each port being tested with a known good 50 Ω load (greater than -30 dB). The resulting return loss should be greater than –10 dB (the absolute value should be greater than 10 dB).

The "Cycle" program can be used instead. It will prompt the user to perform an S11 one-port calibration, then it will cycle through all twelve ports automatically, displaying each result on screen. It does not, however, measure the actual results.

Please note that this is an 80% confidence test only. A unit could pass this simple test and yet still not function properly. For more complete testing, see "Performance Tests" on page 48.

Controlling the Test Set and Making Measurements

The 87050A Option K22 is considered a “slave” instrument (a controller must be used to control the test set). There are three ways in which the test set can be controlled:

- The controller can talk to the network analyzer via GPIB (HP-IB), which then controls the test set via the parallel connection.
- The controller can control the test set directly via GPIB (HP-IB).
- A network analyzer equipped with a parallel connection can control the test set directly.

An example program listing is provided at the end of this section.

Typeface Key Conventions

The following key conventions are used throughout this document.

- **[HARDKEYS]** are labeled front panel keys
- **SOFTKEYS** are unlabeled key whose function is indicated on the instrument display

Commands

As mentioned earlier, the test set can be controlled in three ways. The first two involve the use of a separate controller. The third way uses the network analyzer manually. These methods of control are detailed below and on the following page.

Computer Control

The first way to control the test set is to write GPIB commands to the network analyzer which then writes to the test set via the parallel port. See Figure 7 on page 13 for a diagram of connections for this type of control. The second way is to write GPIB commands directly to the test set's GPIB port. Both of the following examples use the variable “D” which is defined in Table 2 on page 15.

To use a parallel port connection with the 8720D, use an GPIB command to write bits on the parallel port. The following example assumes that the address of the network analyzer is 16.

```
OUTPUT 716;"PARALGPIO;"Sets the parallel port for GP-IO function

OUTPUT 716;"PARAOUT[D];"Programs all GP-IO output bits (0 to 256) at once
```

To address the 87050A Option K22 test set directly over GPIB, use a controller to write directly to the test set's GPIB port. The following example assumes that the address of the test set is 12.

```
OUTPUT 712;"STRING$"
```

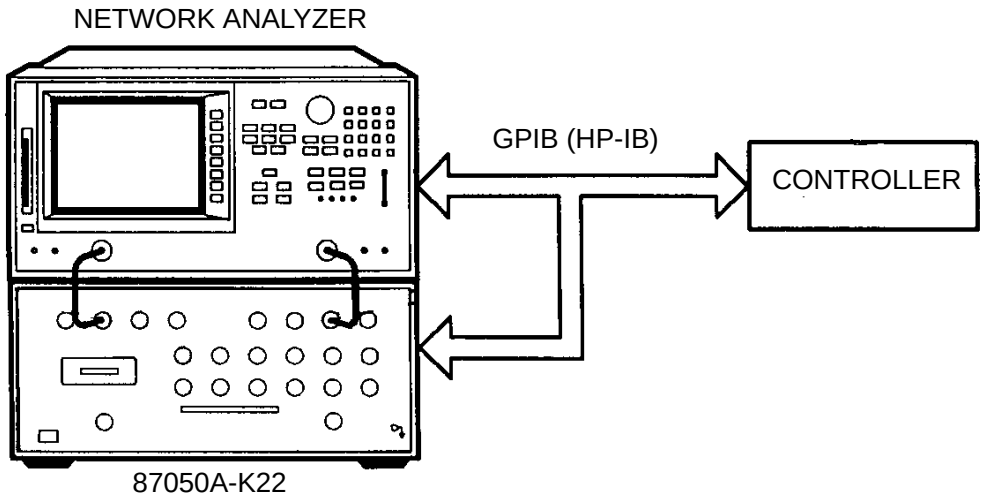
NOTE Commands are case sensitive.

If you are using Quick Basic or Visual Basic, be sure to disable EOI and EOL before sending commands to the test set. Including the semicolon in program commands will not ensure that these commands are disabled as would be the case in HP Basic/RMB. Using the 82335 GPIB Interface and Visual Basic, the following commands will disable EOI and EOL, send the necessary data to the test set, and re-enable EOI and EOL. Be sure to re-enable EOI and EOL before sending data to another instrument.

```
HpibEoi(hHpib;7,0) 'disable EOI
HpibEol(hHpib;7,"",0) 'disable EOL
HpibOutput(hHpib;712,chr$([D])) 'send command to test set
HpibEol(hHpib;7,chr$(13)+chr$(10),2) 're-enable EOL and set to
'chr$(13)+chr$(10)
HpibEoi(hHpib;7,1,) 're-enable EOI
```

where hHpib specifies the handle returned by HpibOpen. For more information on the EOI and EOL commands, refer to the programming library manual supplied with the 82335 interface.

Figure 7 Controlling the Test Set Over GPIB (HP-IB)



NOTE Connection to the network analyzer is not required when controlling the test set over GPIB.

Network Analyzer Control

The third method of sending commands uses the network analyzer to control the test set directly. This method is performed with the standard setup of the network analyzer working with the test set. A parallel cable is connected from the network analyzer output to the test set input on both rear panels.

Press: **[SEQ] TTL I/O PARALLEL ALL OUT**

Use the arrow keys, ⇑ or ⇓, to scroll to the desired test port address, or input the number directly using the hardkeys **[D]** → **[x1]**, where **D** represents the decimal value of the test port address, see Table 2 on page 15.

Table 2 Test Port Addresses

Connection Path	GPIB Command	Decimal	Binary Equivalent
A1 to PORT 1	a1p1		
A1 to PORT 2	a1p2		
A1 to PORT 3	a1p3		
A1 to PORT 4	a1p4		
A1 to PORT 5	a1p5		
A1 to PORT 6	a1p6		
A1 to PORT 7	a1p7		
A1 to PORT 8	a1p8		
A1 to PORT 9	a1p9		
A1 to PORT 10	a1p10		
A1 to PORT 11	a1p11		
A1 to PORT 12	a1p12		
A1 to AUX1	a1aux		
A1 to B1	a1b1		
A1 to B2	a1b2		
A1 to B3	a1b3		
A1 to B4	a1b4		
A2 to PORT 1	a2p1	13	00001101
A2 to PORT 2	a2p2	14	00001110
A2 to PORT 3	a2p3	15	00001111
A2 to PORT 4	a2p4	16	00010000
A2 to PORT 5	a2p5	17	00010001
A2 to PORT 6	a2p6	18	00010010
A2 to PORT 7	a2p7	19	00010011
A2 to PORT 8	a2p8	20	00010100
A2 to PORT 9	a2p9	21	00010101
A2 to PORT 10	a2p10	22	00010110
A2 to PORT 11	a2p11	23	00010111
A2 to PORT 12	a2p12	24	00011000
A2 to AUX1	a2aux	25	00011001

Table 2 Test Port Addresses

Connection Path	GPIB Command	Decimal	Binary Equivalent
A2 to B1	a2b1		
A2 to B2	a2b2		
A2 to B3	a2b3		
A2 to B4	a2b4		
A3 to PORT 1	a3p1		
A3 to PORT 2	a3p2		
A3 to PORT 3	a3p3		
A3 to PORT 4	a3p4		
A3 to PORT 5	a3p5		
A3 to PORT 6	a3p6		
A3 to PORT 7	a3p7		
A3 to PORT 8	a3p8		
A3 to PORT 9	a3p9		
A3 to PORT 10	a3p10		
A3 to PORT 11	a3p11		
A3 to PORT 12	a3p12		
A3 to AUX1	a3aux		
A3 to B1	a3b1		
A3 to B2	a3b2		
A3 to B3	a3b3		
A3 to B4	a3b4		
A4 to PORT 1	a4p1		
A4 to PORT 2	a4p2		
A4 to PORT 3	a4p3		
A4 to PORT 4	a4p4		
A4 to PORT 5	a4p5		
A4 to PORT 6	a4p6		
A4 to PORT 7	a4p7		
A4 to PORT 8	a4p8		

Table 2 Test Port Addresses

Connection Path	GPIB Command	Decimal	Binary Equivalent
A4 to PORT 9	a4p9		
A4 to PORT 10	a4p10		
A4 to PORT 11	a4p11		
A4 to PORT 12	a4p12		
A4 to AUX1	a4aux		
A4 to B1	a4b1		
A4 to B2	a4b2		
A4 to B3	a4b3		
A4 to B4	a4b4		
A1-4 TERMINATED	aterm	52	00110100
B1 to PORT 1	b1p1		
B1 to PORT 2	b1p2		
B1 to PORT 3	b1p3		
B1 to PORT 4	b1p4		
B1 to PORT 5	b1p5		
B1 to PORT 6	b1p6		
B1 to PORT 7	b1p7		
B1 to PORT 8	b1p8		
B1 to PORT 9	b1p9		
B1 to PORT 10	b1p10		
B1 to PORT 11	b1p11		
B1 to PORT 12	b1p12		
B1 to AUX2	b1aux	65	01000001
B2 to PORT 1	b2p1	66	01000010
B2 to PORT 2	b2p2	67	01000011
B2 to PORT 3	b2p3	68	01000100
B2 to PORT 4	b2p4	69	01000101
B2 to PORT 5	b2p5	70	01000110
B2 to PORT 6	b2p6	71	01000111

Table 2 Test Port Addresses

Connection Path	GPIB Command	Decimal	Binary Equivalent
B2 to PORT 7	b2p7	72	01001000
B2 to PORT 8	b2p8	73	01001001
B2 to PORT 9	b2p9	74	01001010
B2 to PORT 10	b2p10	75	01001011
B2 to PORT 11	b2p11	76	01001100
B2 to PORT 12	b2p12	77	01001101
B2 to AUX2	b2aux	78	01001110
B3 to PORT 1	b3p1		
B3 to PORT 2	b3p2		
B3 to PORT 3	b3p3		
B3 to PORT 4	b3p4		
B3 to PORT 5	b3p5		
B3 to PORT 6	b3p6		
B3 to PORT 7	b3p7		
B3 to PORT 8	b3p8		
B3 to PORT 9	b3p9		
B3 to PORT 10	b3p10		
B3 to PORT 11	b3p11		
B3 to PORT 12	b3p12		
B3 to AUX2	b3aux		
B4 to PORT 1	b4p1		
B4 to PORT 2	b4p2		
B4 to PORT 3	b4p3		
B4 to PORT 4	b4p4		
B4 to PORT 5	b4p5		
B4 to PORT 6	b4p6		
B4 to PORT 7	b4p7		
B4 to PORT 8	b4p8		
B4 to PORT 9	b4p9		

Table 2 Test Port Addresses

Connection Path	GPIB Command	Decimal	Binary Equivalent
B4 to PORT 10	b4p10		
B4 to PORT 11	b4p11		
B4 to PORT 12	b4p12		
B4 to AUX2	b4aux		
B1-4 TERMINATED	bterm	105	01101001
SERIAL NUMBER	sn?		Returns serial number in a string over the GP-IB
RESET[1]	*rst		
RESET2[2]	*rst2		
BOX IDENTITY	idn?		Displays on LCD display only

1. Previously, one reset command (*rst) resided in the firmware. See Figure 8 on page 20 for switch and port configuration. This command resets all switches.
2. The new reset command (*rst2) resets only sw14, sw15, sw16, sw17 and sw50 through sw61. See Figure 9 on page 20 for switch and port configuration. Switches sw10 and sw13 do not change from their previous settings.

To connect all ports to their internal 50 Ω loads, send the following two commands:

```
OUTPUT 716;"PARAOUT52;"

OUTPUT 716;"PARAOUT105;" or

OUTPUT 712;"aterm"

OUTPUT 712;"bterm"
```

NOTE When a test set port is not in use, it is terminated in 50 Ω.

To read the Serial Number, send the following two commands:

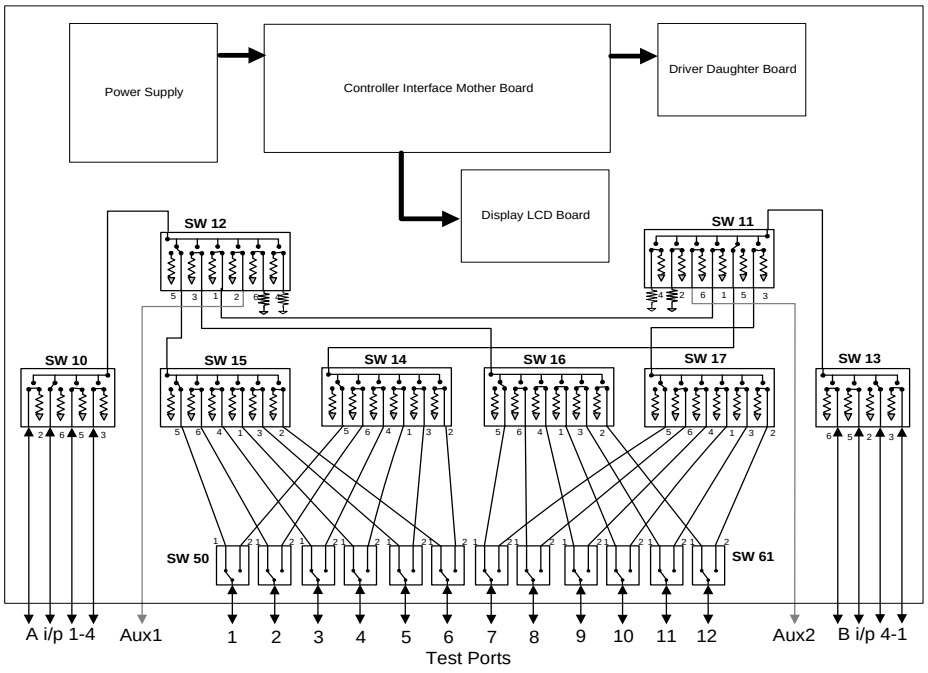
```
OUTPUT 712;"sn?"

ENTER 712;S$
```

Reset Command:

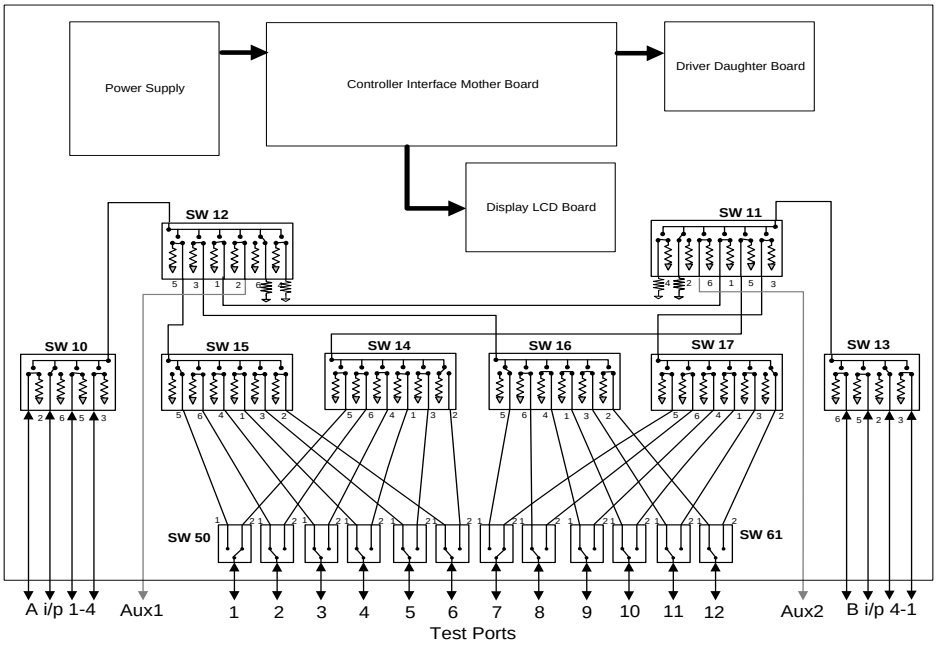
When the *rst is set, the instrument is set to a known state where all ports are terminated.

Figure 8 Switch and Port Configuration



Agilent 87050A Option K22
Multi-Function Switch Matrix

Figure 9 Switch 14-17 and Switch 50-61



Agilent 87050A Option K22
Multi-Function Switch Matrix

Table 3 Switch Count Commands

Switch Number	GPIB Command
J10	sw10?
J11	sw11?
J12	sw12?
J13	sw13?
J14	sw14?
J15	sw15?
J16	sw16?
J17	sw17?
J50	sw50?
J51	sw51?
J52	sw52?
J53	sw53?
J54	sw54?
J55	sw55?
J56	sw56?
J57	sw57?
J58	sw58?
J59	sw59?
J60	sw60?
J61	sw61?

To read the individual Switch Count, send the following two commands:

```
OUTPUT 712;"sw10?"

ENTER 712;J10$
```

The example above illustrates the J10 command only, to enter additional commands refer to Table 3.

Individual GPIB Switch Selection

Individual positioning of switches sw14, sw15, sw16, sw17 and sw50 through sw61 is also available with Rev0106. This allows the user to customize the 87050A Option K22 multiport configuration and to minimize the switch count “wear and tear” on the instrument. The new GPIB commands for this feature are listed in Table 4 on page 23. You must take care as to where the switches are in relation to the desired port selection when using these commands. The LCD indicates that the user has changed the configuration and that prior port selection may be invalid. The LCD Displays “CONFIGURATION MODIFIED.”

Additional GPIB Commands

In these GPIB commands (swXXY), swXX selects the switch. The last digit Y sets the switch port path. For example, in the command sw146, sw14 selects switch 14 and the final 6 sets the switch port path to 6. See Table 4.

Table 4 Additional GPIB Commands

Connection Path	GPIB Command
Switch 14 set to 1	sw141
Switch 14 set to 2	sw142
Switch 14 set to 3	sw143
Switch 14 set to 4	sw144
Switch 14 set to 5	sw145
Switch 14 set to 6	sw146
Switch 15 set to 1	sw151
Switch 15 set to 2	sw152
Switch 15 set to 3	sw153
Switch 15 set to 4	sw154
Switch 15 set to 5	sw155
Switch 15 set to 6	sw156
Switch 16 set to 1	sw161
Switch 16 set to 2	sw162
Switch 16 set to 3	sw163
Switch 16 set to 4	sw164
Switch 16 set to 5	sw165
Switch 16 set to 6	sw166
Switch 17 set to 1	sw171
Switch 17 set to 2	sw172
Switch 17 set to 3	sw173
Switch 17 set to 4	sw174
Switch 17 set to 5	sw175
Switch 17 set to 6	sw176

Calibrating the Test System

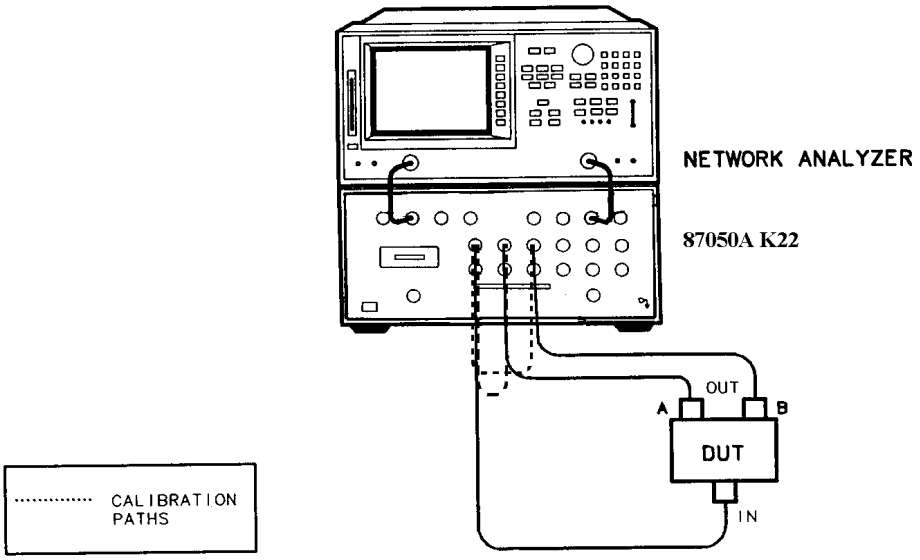
After the test set has warmed up for at least two hours, you should calibrate the instrument before making any measurements. Refer to your network analyzer user's guide to determine the type of calibration appropriate for the measurements you will be making.

You will need to calibrate each measurement path separately and store the calibration as an instrument state in the network analyzer. Refer to your network analyzer user's guide for information on how to calibrate and store instrument states.

In the example setup shown in Figure 10, the following tests will be made:

- Return loss on the DUT's input and 2 output ports (A and B)
- Insertion loss (or gain) between the DUT's input and port A
- Insertion loss (or gain) between the DUT's input and port B

Figure 10 Calibrating the Test System



For the best accuracy, you should perform a full 2-port calibration between ports 1 and 3 on the test set, and again between ports 1 and 5. As mentioned before, you need to save the calibrations as instrument states. See your analyzer user's guide for information on calibrations and saving instrument states.

CAUTION When performing a full 2-port calibration and making subsequent measurements, you must use the transfer switch internal to the 8720D to change the RF signal path direction. Do not use the test set to change the RF signal path direction when you are using a full 2-port calibration. Doing so will render the calibration invalid.

Making Measurements

The following examples assume that you are using a parallel port connection with an 8720D, with the test set's parallel address set to “0”. See "Setting the Test Set Address Switch" on page 9 for information on setting the test set's address.

Measuring Transmission

Refer to Figure 11 for the following discussion. With the 87050A Option K22 test set to measure forward transmission (S_{21}), the analyzer's RF source is being output through the analyzer's PORT 1, and PORT 2 is set to receive the RF signal.

By using the following commands, you will connect PORT 3 of the test set to the A i/p 2 port, and you will connect PORT 8 of the test set to the B i/p 2 port. You will thus be measuring forward transmission through the device under test when measuring S_{21}. This will provide you with gain or insertion loss information.

```
OUTPUT 716;"PARALGPIO;"

OUTPUT 716;"PARAOUT15;"

OUTPUT 716;"PARALGPIO;"

OUTPUT 716;"PARAOUT73;"
```

If directly controlling the 87050A Option K22, use the following GPIB commands:

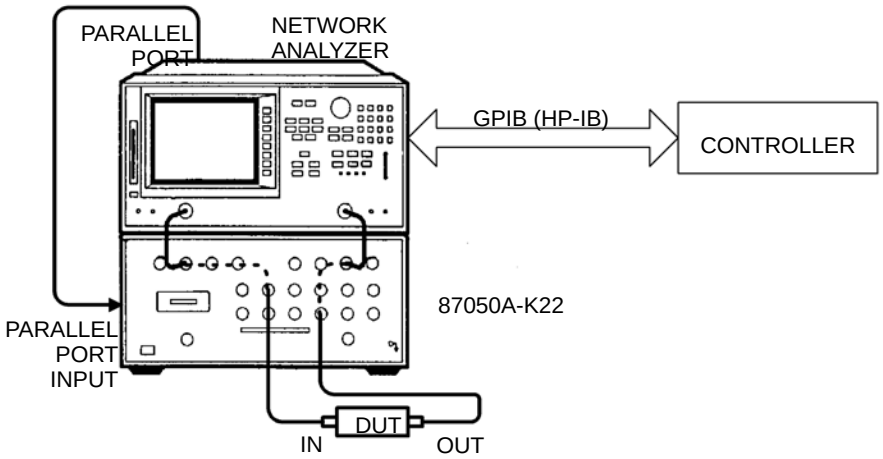
```
OUTPUT 712;"a2p3"

OUTPUT 712;"b2p8"
```

Measuring Reflection

By leaving the DUT connected as in Figure 11, and setting the network analyzer to measure S_{11}, you can measure reflection or return loss.

Figure 11 Controlling the Test Set



Example Programs

These programs are written in HP BASIC and are for use with an HP 9000 series 200/300/700 computer. The programs are briefly described below and the control program is listed following the description.

CONTROL	A program that demonstrates the control of the 87050A Option K22 via GPIB and/or the parallel port. This program can be used to manually select any port combination.
CYCLE	This program prompts the user to make an S_{11} one-port cal on the 8720D and then cycles through all twelve test set ports, pausing at each one, so that the user can view the return loss of each port.

The "CONTROL" Program

The "CONTROL" program (listed on the following pages) will first ask the user which method will be used to control the 87050A Option K22; either GPIB or parallel port. It will then ask which ports are to be enabled. The port entries are done in two pairs; four numbers separated by commas. The numbers may range from 0 through 4 for the A i/p and B i/p input ports and 0 through 12 for the test ports. For example, the entry of "2,2,2,5" will connect the A i/p 2 port to PORT 2 and the B i/p 2 port to PORT 5. The program is a continuous loop. Press STOP to end program execution.

```
10 ! RE-SAVE"CONTROL_K22"
20 ! CONTROL: This example program allows "manual" control of the Multiport
     K22 via the parallel port of the 8720D or
30 ! via GPIB directly.
40 !
50 ! NOTE: You MUST select either GPIB control or Parallel Port
60 ! control. If Parallel Port via the 8720D is selected,
70 ! this program will return the analyzer to LOCAL control
80 ! after the switches are set.
90 ! Set GPIB address as required below.
100 ! K22 can be set to one of two Parallel Port addresses.
110 ! This program (SUB Set_switches) assumes it is set to
120 ! address 00.
130 ! Copyright: Agilent Technologies, Palo Alto, CA 94304
140 !
150 !
160 ! Revision A.01.00  07 Jul 1997  rd
```

```
170 Nwa_addr=716  ! 8720D GPIB ADDRESS (IF USED)
180 Ts_addr=712  ! option K22 GPIB ADDRESS (IF USED)
190 !
200 !
210 CLEAR SCREEN
220 PRINT USING "3/,K,/";"***** DEMONSTRATION PROGRAM FOR Multiport K22
    MANUAL CONTROL *****"
230 PRINT "Either direct GPIB control to the K22 may be selected (H), or"
240 PRINT "indirect control via the Parallel Port (P) of the 8720D."
250 REPEAT
260 Answ$="P"
270 OUTPUT 2;Answ$&CHR$(255)&"H";
280 BEEP 300,.1
290 INPUT "Select desired test-set control. GPIB or Parallel Port? (Enter H
    or P)",Answ$
300 Answ$=UPC$(Answ$[1,1])
310 UNTIL Answ$="P" OR Answ$="H"
320 Controller$=Answ$
330 !
340 ABORT 7
350 CLEAR SCREEN
360 IF Controller$="P" THEN
370 Addr=Nwa_addr ! Assign address to the analyzer
380 PRINT "Test set is being controlled via Parallel Port; 8720D GPIB address
    =";Addr
390 ELSE
400 Addr=Ts_addr
410 CLEAR Addr
420 PRINT "Test set is being controlled directly via GPIB. GPIB address
    =";Addr
430 END IF
440 Isc=Addr DIV 100 ! Interface Select Code
450 !
460 PRINT USING "/,K,/";RPT$("-",77)
470 PRINT "For manual operation of this switch box, enter FOUR numbers
    separated by a"
480 PRINT "comma (,). The four numbers represent the A I/P port, Test port, B
    I/P port"
```

```
490 PRINT "and Test port to be used (respectively). Setting a port to `0'
    will"
500 PRINT "terminate the corresponding port."
510 PRINT "Unless both numbers are `0', the two values cannot be the same."
520 PRINT "To terminate program, press STOP or PAUSE"
530 PRINT
540 PRINT "Example: 1,2,2,3 sets the switch box A1 I/P to Port 2 and B2 I/P
    to"
550 PRINT "Port 3.  2,4,2,0 sets A2 I/P port to Port 4; B2  I/P is not used."
560 PRINT "To set A1 I/P to AUX1 and B1 I/P to AUX2 enter 1,13,1,13."
561 PRINT ""
570 PRINT " If you have selected GPIB you may also check the serial number"
580 PRINT "of the unit by typing SERIAL, or check the number of times the"
590 PRINT "switch has switched by typing SWITCH ##, where ## is the number"
600 LOOP
620    Refl=0
630    Trans=0
640    Ain=0
650    Bin=0
660    BEEP 500,.1
670    LINPUT "Enter the Ain/Port,Bin/Port Port selections separated by
       commas: e.g. 1,2,2,4",Command$
680    Current_pos=POS(Command$,",")
690    Command_length=LEN(Command$)
700    Counter=0
710    IF Current_pos>0 THEN
720       WHILE Current_pos>0
730          Command_length=LEN(Command$)
740          Current$=Command$[1,(Current_pos-1)]
750           Command$=Command$[(Current_pos+1),
             Command_length]
760          Current_pos=POS(Command$,",")
770          Set_no=VAL(Current$)
780          SELECT Counter
790          CASE 0
800            Ain=Set_no
810          CASE 1
```

```
820             Refl=Set_no
830           CASE 2
840             Bin=Set_no
850           CASE 3
860             Trans=Set_no
870           CASE ELSE
880             PRINT "Too many numbers"
890           END SELECT
900           Counter=Counter+1
910           END WHILE
920           Set_no=VAL(Command$)
930           Trans=Set_no
940         IF NOT (((Refl<>Trans) OR (Refl=0 AND Trans=0) OR
            (Trans=13 AND Refl=13)) AND Refl<14 AND Trans<14 AND Refl>=0 AND
            Trans>=0) THEN
950         DISP "Port selections MUST be different if non-zero; Range= 0 to
            13. Try again!"
960         BEEP 1500,.3
970         WAIT
980       ELSE
990       IF NOT (Ain<5 AND Bin<5 AND Ain>=0 AND Bin>=0) THEN
1000        DISP "Input port selections MUST be different if non-zero; Range= 0
            to 5.  Try again!"
1010        BEEP 1500,.3
1020        WAIT 5
1030      ELSE
1040        Set_switches(Addr,"REFL",VAL$(Ain),VAL$(Refl),
            Controller$)   ! Sets Reflection Port
1050        Set_switches(Addr,"TRANS",VAL$(Bin),VAL$(Trans),
            Controller$)  ! Sets Transmission Port
1060          PRINT TABXY(1,20),"Current Port = A";Ain;" To ";Refl
1070          PRINT TABXY(1,21),"Current Port = B";Bin;" To ";Trans
1080          END IF
1090        END IF
1100      ELSE
1110        IF POS(Command$,"SERIAL")>0 THEN
1120        OUTPUT 712;"sn?"
1130        ENTER 712;Sn$
```

```
1140      PRINT TABXY(1,23),"serial number is ";Sn$
1150      ELSE
1160        IF POS(Command$,"SWITCH")>0 THEN
1170          Nu$=TRIM$(Command$[7,Command_length])
1180          OUTPUT 712;"sw"&Nu$&"?"
1190          ENTER 712;Count$
1200          PRINT TABXY(1,24),"switch no ";Nu$;" has ";Count$
1210        ELSE
1220          DISP "Unknown command"
1221          WAIT 3
1230        END IF
1240      END IF
1250    END IF
1260    LOCAL Isc
1270 END LOOP
1280 END
1290 !
1300 SUB
     Set_switches(Addr,Main_port$,Input_select$, Switched_port$,Controller$)
1310 !=====================================================
1320 ! PURPOSE: To set the 87050A K22 switches.
1330 !-----------------------------------------------------
1340 !
1350 ! PARAMETERS :
1360 !
1370 ! Controller$   [P|H]  P= Parallel via 8720D or H= GPIB
1380 ! Main_port$    [REFL|TRANS]
1390 ! Switched_port$  [0|1|2|...|13]
1400 ! Addr GPIB addr of 8720D or K22 depending upon H or P above
1410 !-----------------------------------------------------
1420 ! DESCRIPTION:
1430 !
1440 ! Commands can be sent via Centronics (Parallel) port or via GPIB.
1450 ! Choice depends upon variable Controller$ (P/H)
1460 !
1470 !=====================================================
```

```
1480 Set_switches:!
1490 !
1500 SELECT UPC$(TRIM$(Main_port$))
1510 CASE "REFL"
1520    SELECT UPC$(TRIM$(Input_select$))
1530    CASE "0","TERMINATE"
1540      Hswitch_code$="aterm"
1550      Pswitch_code$="52"
1560    CASE "1","A1"
1570      SELECT UPC$(TRIM$(Switched_port$))
1580      CASE "1","PORT 1"
1590         Hswitch_code$="a1p1"
1600         Pswitch_code$="0"
1610       CASE "2","PORT 2"
1620         Hswitch_code$="a1p2"
1630         Pswitch_code$="1"
1640       CASE "3","PORT 3"
1650         Hswitch_code$="a1p3"
1660         Pswitch_code$="2"
1670       CASE "4","PORT 4"
1680         Hswitch_code$="a1p4"
1690         Pswitch_code$="3"
1700       CASE "5","PORT 5"
1710         Hswitch_code$="a1p5"
1720         Pswitch_code$="4"
1730       CASE "6","PORT 6"
1740         Hswitch_code$="a1p6"
1750         Pswitch_code$="5"
1760       CASE "7","PORT 7"
1770         Hswitch_code$="a1p7"
1780         Pswitch_code$="6"
1790       CASE "8","PORT 8"
1800         Hswitch_code$="a1p8"
1810         Pswitch_code$="7"
1820       CASE "9","PORT 9"
1830         Hswitch_code$="a1p9"
```

```
1840          Pswitch_code$="8"
1850        CASE "10","PORT 10"
1860          Hswitch_code$="a1p10"
1870          Pswitch_code$="9"
1880        CASE "11","PORT 11"
1890          Hswitch_code$="a1p11"
1900          Pswitch_code$="10"
1910        CASE "12","PORT 12"
1920          Hswitch_code$="a1p12"
1930          Pswitch_code$="11"
1940        CASE "13","AUX 1"
1950          Hswitch_code$="a1aux"
1960          Pswitch_code$="12"
1970        CASE "0","TERMINATE","RESET"
1980          Hswitch_code$="aterm"
1990          Pswitch_code$="52"
2000        CASE ELSE

2010          DISP "Unrecognized Switched_port$ parameter;
              """&Switched_port$&"""
2020          STOP
2030        END SELECT
2040      CASE "2","A2"
2050        SELECT UPC$(TRIM$(Switched_port$))
2060        CASE "1","PORT 1"
2070          Hswitch_code$="a2p1"
2080          Pswitch_code$="13"
2090        CASE "2","PORT 2"
2100          Hswitch_code$="a2p2"
2110          Pswitch_code$="14"
2120        CASE "3","PORT 3"
2130          Hswitch_code$="a2p3"
2140          Pswitch_code$="15" 2
2150        CASE "4","PORT 4"
2160          Hswitch_code$="a2p4"
2170          Pswitch_code$="16"
```

```
2180        CASE "5","PORT 5"
2190          Hswitch_code$="a2p5"
2200          Pswitch_code$="17"
2210        CASE "6","PORT 6"
2220          Hswitch_code$="a2p6"
2230          Pswitch_code$="18"
2240        CASE "7","PORT 7"
2250          Hswitch_code$="a2p7"
2260          Pswitch_code$="19"
2270        CASE "8","PORT 8"
2280          Hswitch_code$="a2p8"
2290          Pswitch_code$="20"
2300        CASE "9","PORT 9"
2310          Hswitch_code$="a2p9"
2320          Pswitch_code$="21"
2330        CASE "10","PORT 10"
2340          Hswitch_code$="a2p10"
2350          Pswitch_code$="22"
2360        CASE "11","PORT 11"
2370          Hswitch_code$="a2p11"
2380          Pswitch_code$="23"
2390        CASE "12","PORT 12"
2400          Hswitch_code$="a2p12"
2410          Pswitch_code$="24"
2420        CASE "13","AUX 1"
2430          Hswitch_code$="a2aux"
2440          Pswitch_code$="25"
2450        CASE "0","TERMINATE","RESET"
2460          Hswitch_code$="aterm"
2470          Pswitch_code$="52"
2480        CASE ELSE
2490          DISP "Unrecognized Switched_port$ parameter;
              """&Switched_port$&""""
2500          STOP
2510        END SELECT
2520      CASE "3","A3"
```

```
2530       SELECT UPC$(TRIM$(Switched_port$))
2540       CASE "1","PORT 1"
2550         Hswitch_code$="a3p1"
2560         Pswitch_code$="26
2570       CASE "2","PORT 2"
2580         Hswitch_code$="a3p2"
2590         Pswitch_code$="27"
2600       CASE "3","PORT 3"
2610         Hswitch_code$="a3p3"
2620         Pswitch_code$="28"
2630       CASE "4","PORT 4"
2640         Hswitch_code$="a3p4"
2650         Pswitch_code$="29"
2660       CASE "5","PORT 5"
2670         Hswitch_code$="a3p5"
2680         Pswitch_code$="30
2690       CASE "6","PORT 6"
2700         Hswitch_code$="a3p6"
2710         Pswitch_code$="31"
2720       CASE "7","PORT 7"
2730         Hswitch_code$="a3p7"
2740         Pswitch_code$="32"
2750       CASE "8","PORT 8"
2760         Hswitch_code$="a3p8"
2770         Pswitch_code$="33"
2780       CASE "9","PORT 9"
2790         Hswitch_code$="a3p9"
2800         Pswitch_code$="34"
2810       CASE "10","PORT 10"
2820         Hswitch_code$="a3p10"
2830         Pswitch_code$="35"
2840       CASE "11","PORT 11"
2850         Hswitch_code$="a3p11"
2860         Pswitch_code$="36"
2870       CASE "12","PORT 12"
2880         Hswitch_code$="a3p12"
```

```
2890          Pswitch_code$="37"
2900        CASE "13","AUX 1"
2910          Hswitch_code$="a3aux"
2920          Pswitch_code$="38"
2930        CASE "0","TERMINATE","RESET"
2940          Hswitch_code$="aterm"
2950          Pswitch_code$="52"
2960        CASE ELSE
2970            DISP "Unrecognized Switched_port$ parameter;
                """&Switched_port$&"""
2980          STOP
2990        END SELECT
3000      CASE "4","A4"
3010        SELECT UPC$(TRIM$(Switched_port$))
3020        CASE "1","PORT 1"
3030          Hswitch_code$="a4p1"
3040          Pswitch_code$="39"
3050        CASE "2","PORT 2"
3060          Hswitch_code$="a4p2"
3070          Pswitch_code$="40"
3080        CASE "3","PORT 3"
3090          Hswitch_code$="a4p3"
3100          Pswitch_code$="41"
3110        CASE "4","PORT 4"
3120          Hswitch_code$="a4p4"
3130          Pswitch_code$="42"
3140        CASE "5","PORT 5"
3150          Hswitch_code$="a4p5"
3160          Pswitch_code$="43"
3170        CASE "6","PORT 6"
3180          Hswitch_code$="a4p6"
3190          Pswitch_code$="44"
3200        CASE "7","PORT 7"
3210          Hswitch_code$="a4p7"
3220          Pswitch_code$="45"
3230        CASE "8","PORT 8"
```

```
3240         Hswitch_code$="a4p8"
3250         Pswitch_code$="46"
3260       CASE "9","PORT 9"
3270         Hswitch_code$="a4p9"
3280         Pswitch_code$="47"
3290       CASE "10","PORT 10"
3300         Hswitch_code$="a4p10"
3310         Pswitch_code$="48"
3320       CASE "11","PORT 11"
3330         Hswitch_code$="a4p11"
3340         Pswitch_code$="49"
3350       CASE "12","PORT 12"
3360         Hswitch_code$="a4p12"
3370         Pswitch_code$="50"
3380       CASE "13","AUX 1"
3390         Hswitch_code$="a4aux"
3400         Pswitch_code$="51"
3410       CASE "0","TERMINATE","RESET"
3420         Hswitch_code$="aterm"
3430         Pswitch_code$="52"
3440       CASE ELSE
3450         DISP "Unrecognized Switched_port$ parameter;
             """&Switched_port$&"""
3460         STOP
3470       END SELECT
3480    END SELECT
3490 !
3500 CASE "TRANS"
3510    SELECT UPC$(TRIM$(Input_select$))
3520    CASE "0","TERMINATE"
3530       Hswitch_code$="bterm"
3540       Pswitch_code$="105"
3550    CASE "1","B1"
3560       SELECT UPC$(TRIM$(Switched_port$))
3570       CASE "1","PORT 1"
3580         Hswitch_code$="b1p1"
```

```
3590          Pswitch_code$="53"
3600        CASE "2","PORT 2"
3610          Hswitch_code$="b1p2"
3620          Pswitch_code$="54"
3630        CASE "3","PORT 3"
3640          Hswitch_code$="b1p3"
3650          Pswitch_code$="55"
3660        CASE "4","PORT 4"
3670          Hswitch_code$="b1p4"
3680          Pswitch_code$="56"
3690        CASE "5","PORT 5"
3700          Hswitch_code$="b1p5"
3710          Pswitch_code$="57"
3720        CASE "6","PORT 6"
3730          Hswitch_code$="b1p6"
3740          Pswitch_code$="58"
3750        CASE "7","PORT 7"
3760          Hswitch_code$="b1p7"
3770          Pswitch_code$="59"
3780        CASE "8","PORT 8"
3790          Hswitch_code$="b1p8"
3800          Pswitch_code$="60"
3810        CASE "9","PORT 9"
3820          Hswitch_code$="b1p9"
3830          Pswitch_code$="61"
3840        CASE "10","PORT 10"
3850          Hswitch_code$="b1p10"
3860          Pswitch_code$="62"
3870        CASE "11","PORT 11"
3880          Hswitch_code$="b1p11"
3890          Pswitch_code$="63"
3900        CASE "12","PORT 12"
3910          Hswitch_code$="b1p12"
3920          Pswitch_code$="64"
3930        CASE "13","PORT AUX 2"
3940          Hswitch_code$="b1aux"
```

```
3950          Pswitch_code$="65"
3960        CASE "0","TERMINATE","RESET"
3970          Hswitch_code$="bterm"
3980          Pswitch_code$="105"
3990        CASE ELSE

4000          DISP "Unrecognized Switched_port$ parameter;
              """&Switched_port$&"""
4010          STOP
4020        END SELECT
4030      CASE "2","B2"
4040        SELECT UPC$(TRIM$(Switched_port$))
4050        CASE "1","PORT 1"
4060          Hswitch_code$="b2p1"
4070          Pswitch_code$="66"
4080        CASE "2","PORT 2"
4090          Hswitch_code$="b2p2"
4100          Pswitch_code$="67"
4110        CASE "3","PORT 3"
4120          Hswitch_code$="b2p3"
4130          Pswitch_code$="68"
4140        CASE "4","PORT 4"
4150          Hswitch_code$="b2p4"
4160          Pswitch_code$="69"
4170        CASE "5","PORT 5"
4180          Hswitch_code$="b2p5"
4190          Pswitch_code$="70"
4200        CASE "6","PORT 6"
4210          Hswitch_code$="b2p6"
4220          Pswitch_code$="71"
4230        CASE "7","PORT 7"
4240          Hswitch_code$="b2p7"
4250          Pswitch_code$="72"
4260        CASE "8","PORT 8"
4270          Hswitch_code$="b2p8"
4280          Pswitch_code$="73"
```

```
4290        CASE "9","PORT 9"
4300          Hswitch_code$="b2p9"
4310          Pswitch_code$="74"
4320        CASE "10","PORT 10"
4330          Hswitch_code$="b2p10"
4340          Pswitch_code$="75"
4350        CASE "11","PORT 11"
4360          Hswitch_code$="b2p11"
4370          Pswitch_code$="76"
4380        CASE "12","PORT 12"
4390          Hswitch_code$="b2p12"
4400          Pswitch_code$="77"
4410        CASE "13","PORT AUX 2"
4420          Hswitch_code$="b2aux"
4430          Pswitch_code$="78"
4440        CASE "0","TERMINATE","RESET"
4450          Hswitch_code$="bterm"
4460          Pswitch_code$="105"
4470        CASE ELSE
4480          DISP "Unrecognized Switched_port$ parameter;
              """&Switched_port$&"""
4490          STOP
4500        END SELECT
4510     CASE "3","B3"
4520        SELECT UPC$(TRIM$(Switched_port$))
4530        CASE "1","PORT 1"
4540          Hswitch_code$="b3p1"
4550          Pswitch_code$="79"
4560        CASE "2","PORT 2"
4570          Hswitch_code$="b3p2"
4580          Pswitch_code$="80"
4590        CASE "3","PORT 3"
4600          Hswitch_code$="b3p3"
4610          Pswitch_code$="81"
4620        CASE "4","PORT 4"
4630          Hswitch_code$="b3p4"
```

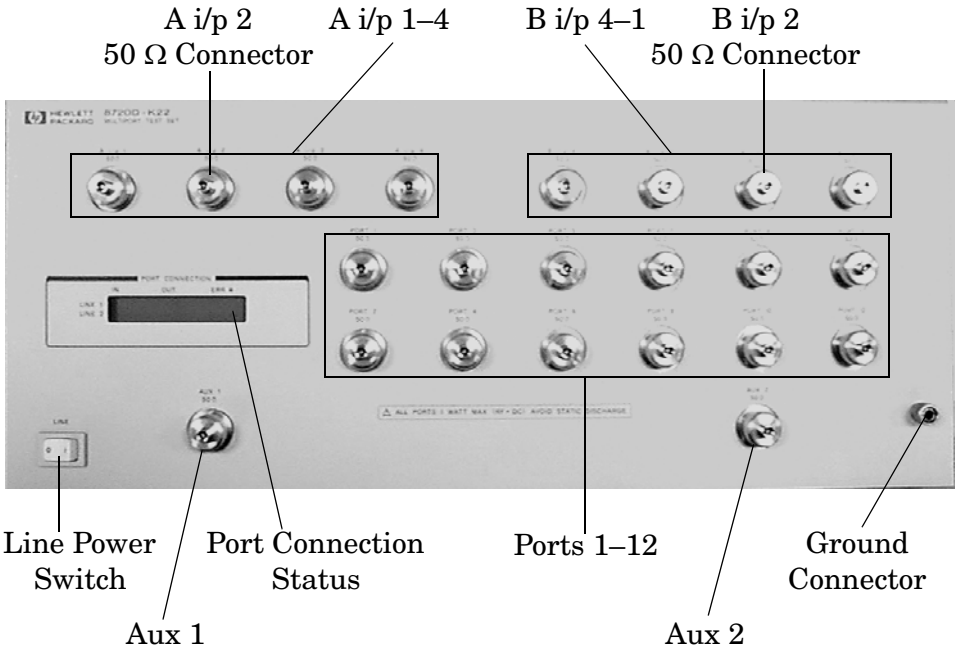
```
4640          Pswitch_code$="82"
4650        CASE "5","PORT 5"
4660          Hswitch_code$="b3p5"
4670          Pswitch_code$="83"
4680        CASE "6","PORT 6"
4690          Hswitch_code$="b3p6"
4700          Pswitch_code$="84"
4710        CASE "7","PORT 7"
4720          Hswitch_code$="b3p7"
4730          Pswitch_code$="85"
4740        CASE "8","PORT 8"
4750          Hswitch_code$="b3p8"
4760          Pswitch_code$="86"
4770        CASE "9","PORT 9"
4780          Hswitch_code$="b3p9"
4790          Pswitch_code$="87"
4800        CASE "10","PORT 10"
4810          Hswitch_code$="b3p10"
4820          Pswitch_code$="88"
4830        CASE "11","PORT 11"
4840          Hswitch_code$="b3p11"
4850          Pswitch_code$="89"
4860        CASE "12","PORT 12"
4870          Hswitch_code$="b3p12"
4880          Pswitch_code$="90"
4890        CASE "13","PORT AUX 2"
4900          Hswitch_code$="b3aux"
4910          Pswitch_code$="91"
4920        CASE "0","TERMINATE","RESET"
4930          Hswitch_code$="bterm"
4940          Pswitch_code$="105"
4950        CASE ELSE
4960          DISP "Unrecognized Switched_port$ parameter;
              """&Switched_port$&"""
4970          STOP
4980        END SELECT
```

```
4990    CASE "4","B4"
5000       SELECT UPC$(TRIM$(Switched_port$))
5010       CASE "1","PORT 1"
5020         Hswitch_code$="b4p1"
5030         Pswitch_code$="92"
5040       CASE "2","PORT 2"
5050         Hswitch_code$="b4p2"
5060         Pswitch_code$="93"
5070       CASE "3","PORT 3"
5080         Hswitch_code$="b4p3"
5090         Pswitch_code$="94"
5100       CASE "4","PORT 4"
5110         Hswitch_code$="b4p4"
5120         Pswitch_code$="95"
5130       CASE "5","PORT 5"
5140         Hswitch_code$="b4p5"
5150         Pswitch_code$="96"
5160       CASE "6","PORT 6"
5170         Hswitch_code$="b4p6"
5180         Pswitch_code$="97"
5190       CASE "7","PORT 7"
5200         Hswitch_code$="b4p7"
5210         Pswitch_code$="98"
5220       CASE "8","PORT 8"
5230         Hswitch_code$="b4p8"
5240         Pswitch_code$="99"
5250       CASE "9","PORT 9"
5260         Hswitch_code$="b4p9"
5270         Pswitch_code$="100"
5280       CASE "10","PORT 10"
5290         Hswitch_code$="b4p10"
5300         Pswitch_code$="101"
5310       CASE "11","PORT 11"
5320         Hswitch_code$="b4p11"
5330         Pswitch_code$="102"
5340       CASE "12","PORT 12"
```

```
5350          Hswitch_code$="b4p12"
5360          Pswitch_code$="103"
5370        CASE "13","PORT AUX 2"
5380          Hswitch_code$="b4aux"
5390          Pswitch_code$="104"
5400        CASE "0","TERMINATE","RESET"
5410          Hswitch_code$="bterm"
5420          Pswitch_code$="105"
5430        CASE ELSE
5440          DISP "Unrecognized Switched_port$ parameter;
              """&Switched_port$&"""
5450          STOP
5460        END SELECT
5470      CASE ELSE
5480        DISP "Unrecognized Main_port$ parameter;
            """&Main_port$&"""
5490        STOP
5500      END SELECT
5510    END SELECT
5520    !
5530    IF Controller$="H" THEN
5540      Output_cmd$=TRIM$(Hswitch_code$)
5550      OUTPUT Addr;Output_cmd$   ! sent via GPIB
5560    ELSE
5570      Output_cmd$=VAL$(VAL(Pswitch_code$))
5580      OUTPUT Addr;"PARALGPIO;"      ! sent via Centronics
5590      OUTPUT Addr;"PARAOUT"&Output_cmd$&";"  ! port
5600    END IF
5610    WAIT .1
5620    SUBEND
5630    !*************************************************
```

Front Panel

Figure 12 Front Panel Features



Line Power Switch

The test set line POWER switch is located at the bottom left corner of the front panel. See Figure 12. The line POWER switch turns the power to the test set either on or off.

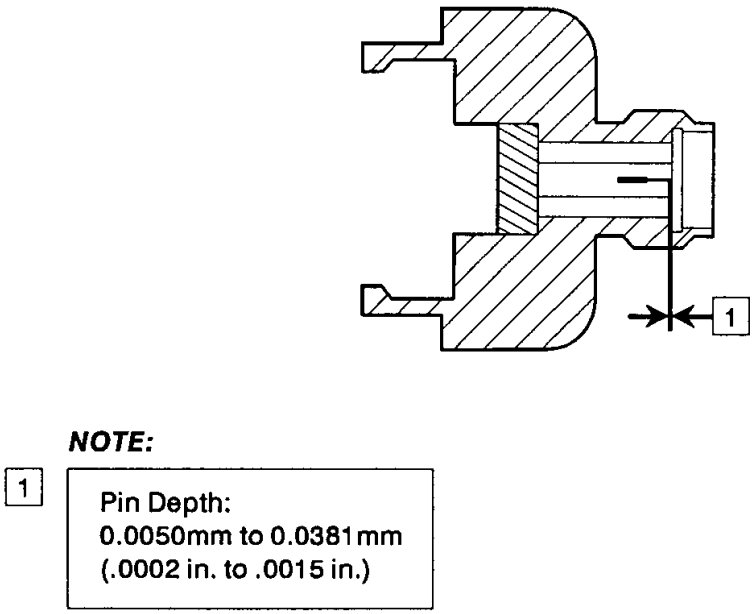
The front panel line POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument

Ports 1–12

Ports 1 through 12 are 50 Ω connectors that are used to connect to the device under test.

CAUTION Do not input more than 1 Watt maximum RF+DC to these ports or damage to the internal RF switches or the analyzer may occur.

Figure 13 Physical Description of 3.5 mm Connector



CAUTION Refer to your analyzer's documentation for damage limits to the RF IN and RF OUT ports. Make sure that your test setup will not cause those limits to be exceeded.

The A i/p 1 through 4 Connectors

The A i/p 1 through 4 connectors are female 3.5 mm 50 Ω connectors. A 50 Ω cable connects directly to the reflection or Port 1 port of the network analyzer using the cable (08720-20245) that was shipped with your test set.

The B i/p 1 through 4 Connectors

The B i/p 1 through 4 are female 3.5 mm 50 Ω connectors. A 50 Ω cable connects directly to the transmission or Port 2 port of the network analyzer using the cables (p/n 08720-20245) that were shipped with your test set.

The GROUND Connector

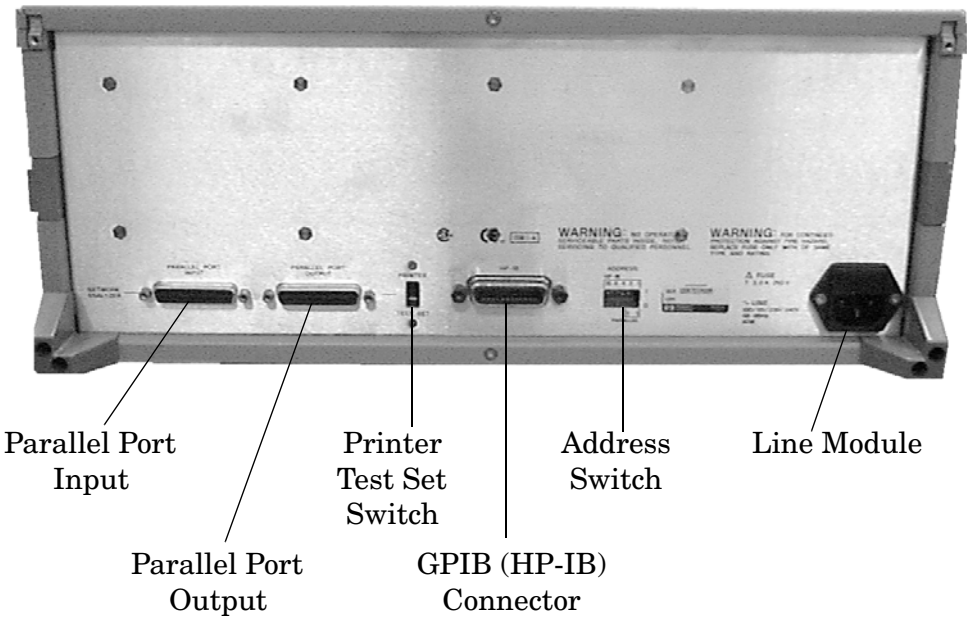
The GROUND connector provides a convenient front panel ground connection for a standard banana plug.

The PORT CONNECTION Status LCD

The PORT CONNECTION status LCD provides visual feedback of which port(s) are connected to the A i/p and B i/p ports of the test set. When the LCD displays a path connection, all other corresponding test ports are internally terminated in 50 Ω.

Rear Panel

Figure 14 Rear Panel Features



The PARALLEL PORT INPUT Connector

This input is connected to the network analyzer. The analyzer provides control signals that drive the switches inside the test set. In pass-through mode, it also accepts signals required to drive a printer.

The PARALLEL PORT OUTPUT Connector

The output from this connector is used to either control another test set, or to control a printer, depending upon how the PRINTER/TEST SET switch is set.

The PRINTER/TEST SET Switch

This switch determines the function of the PARALLEL PORT OUTPUT connector. When switched to PRINTER, the PARALLEL PORT OUTPUT will pass-through printer driver signals. When switched to TEST SET, an additional test set can be controlled from the PARALLEL PORT OUTPUT connector.

The GPIB (HP-IB) Connector

This connector allows the test set to be connected directly to a controller.
See Figure 11 on page 25.

Address Switch

The address switch sets the GPIB (HP-IB) and/or parallel address of the test set. See "Setting the Test Set Address Switch" on page 9 for information.

Line Module

The line module contains the power cable receptacle and the line fuse.

Power Cables

The line power cable is supplied in one of several configurations, depending on the destination of the original shipment.

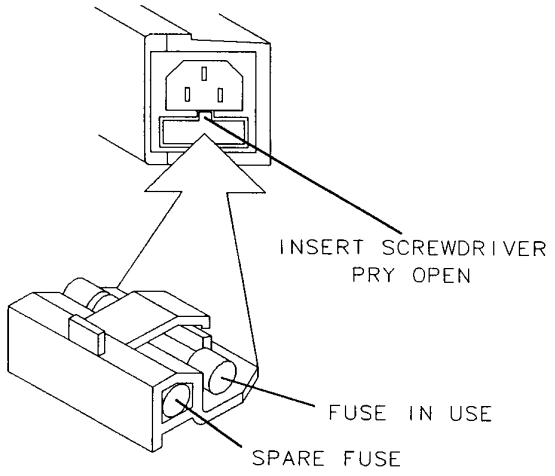
Each instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument chassis. The type of power cable shipped with each instrument depends on the country of destination. See Figure 3 on page 6 for the part numbers of these power cables. Cables are available in different lengths. Check with your nearest Agilent Technologies service center for descriptions and part numbers of cables other than those described in Figure 3. Refer to "Contacting Agilent" on page 74. for further information.

WARNING **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

The Line Fuse

The line fuse (F 3 A/250 V, part number 2110-0780) and a spare reside within the line module. Figure 15 illustrates where the fuses are and how to access them.

Figure 15 Location of Line Fuses



Specifications

The section provides the specifications of the 87050A Option K22.

Table 5 Agilent 87050A Option K22 Specifications

Parameter	Specification
Frequency Range	50 MHz to 20 GHz
Isolation[1]	1) –85 dB[2] 2) –100 dB[3] 3) –95 dB[4] 4) –90 dB[5] 5) –90 dB[6]
Return Loss[7]	6) –24 dB[8] 7) –20 dB[9] 8) –14 dB[4] 9) –10 dB[5] 10) –8 dB[6]
Insertion Loss[10]	11) –2.5 dB[11] 12) –3.5 dB 13) –4.5 dB
Input Power Damage Level	>1 Watt RF + dc

1. Between any two non-connected signal paths
2. Break Down Band 1, 0.50 GHz to 1.3 GHz
3. Break Down Band 2, 1.3 GHz to 3.0 GHz
4. Break Down Band 3, 3.0 GHz to 6.0 GHz
5. Break Down Band 4, 6.0 GHz to 12.4 GHz
6. Break Down Band 5, 12.4 GHz to 20 GHz
7. When externally terminated in 50 Ω
8. Break Down Band 1, 0.5 GHz to 1.3 GHz
9. Break Down Band 2, 1.3 GHz to 3.0 GHz
10. From any test set port to the A i/p or B i/p port
11. Break Down Band 1, 0.5 GHz to 6.0 GHz

Performance Tests

This section contains information to verify the performance of your test set, how to troubleshoot it if necessary, theory of operation and a block diagram.

Performance testing consists of measuring insertion loss, return loss, and isolation between all ports.

Please read all applicable safety warnings and cautions in "Safety and Regulatory Information" on page 68 before servicing the test set.

For the most accurate measurements, the use of an Agilent 8720D 50 Ω network analyzer is recommended and its use is assumed in these notes. Familiarity with RF/microwave measurements is also assumed. The use of adapters may be required and their effects should be accounted for. Performance tests will require the following equipment:

- Agilent 8720D Network Analyzer
- Test Port Extension Cables (85131-60012)
- 85052B Cal Kit
- 909D Option 040 or 0909-60007 50 Ω Load

Make a photocopy of the performance test record pages (later in this section) to record the results of the performance tests. There are no adjustments required for the 87050A Option K22 test set.

Perform a full 2-port calibration from 50 MHz to 20 GHz at the ends of two cables attached to the two test ports of the 8720D. Make sure the calibration is active.

Set up the 8720D with the following:

1. Set the number of points to “201”
2. Set the Bandwidth to “300”
3. Set the 8720D to “Step Sweep”

NOTE The Isolation Cal Routine is done with 16 averages.

Insertion Loss

Step 1. Recall full 2-port calibration.

Step 2. Connect the cable that is attached to PORT 1 of the 8720D to the A i/p 1 port of the 87050A Option K22.

Step 3. Connect the cable from PORT 2 of the analyzer to PORT 1 of the 87050A Option K22. Using the “CONTROL” program provided (see "Example Programs" on page 26), select reflection port 1. e.g., “1,1,0,0” (the selected transmission port does not matter). Verify using Table 5 on page 47. Record the results on the appropriate line in Table 6 on page 52.

Step 4. Repeat step 3 for each of the remaining test ports 2 through 12 and AUX.

Step 5. Repeat step 3 for the A i/p 1–4 ports.

Step 6. Repeat step 2 through step 5, but connect the cable in step 2 to the B i/p 1 port of the 87050A Option K22. In step 2, select only the B i/p 1 port instead of the A i/p 1 port. e.g., “0,0,1,1”.

Step 7. Repeat step 2 through step 5 for the remaining B i/p 2–4 ports.

Return Loss

This test will check both the internal termination load of each port, as well as the through match when the appropriate input port is terminated with a load.

Step 1. Perform a one-port reflection calibration at the end of a 50 Ω cable over the frequency range of 50 MHz to 20 GHz on the analyzer. Verify the calibration is active and that the terminated cable displays a return loss of 0 ±0.2 dB.

Step 2. Connect the cable (already connected to the REFLECTION measurement port of the analyzer) to PORT 1 of the 87050A Option K22. Connect a high-quality 50 Ω load to the A i/p 1 port of the 87050A Option K22. Measure the return loss of PORT 1 by selecting port 1 via the “CONTROL” program. e.g., “1,1,0,0” and viewing the display on the analyzer.

Step 3. Repeat this measurement again, but this time select no active port. e.g. “0,0,0,0”. The display should show “A-Terminated, B-Terminated”.

Step 4. Move the cable to PORT 2 and repeat step 2 and step 3, selecting PORT 2
as the “CONTROL” program entry in step 2. Repeat step 2 and step 3 for the remaining ports.

For the return loss specification for any input match when properly connected, see Table 5 on page 47. Record the test results on the appropriate line in Table 7 on page 53.

Isolation

Isolation need only be measured on adjacent ports. Two 50 Ω loads are required for this test.

Step 1. Recall full 2-port calibration. Make sure the calibration is active and that averaging is “on” when making measurements.

Step 2. Connect a 50 Ω load to both the A i/p 2 and B i/p 2 ports of the 87050A Option K22.

Step 3. Connect the two cables that are attached to the network analyzer to ports 1 and 2
of the 87050A Option K22. The exact order does not matter.

Step 4. Using the “CONTROL” program provided, select reflection port 1 and transmission port 2. e.g. “2,1,2,2” (you could also use “2,2,2,1”). Set the 8720D to measure transmission. Verify using Table 5 on page 47. Record the test results on the appropriate line in Table 8 on page 54.

Step 5. Repeat step 3 and step 4 for the next two adjacent ports; 2 and 3. Make sure the appropriate “CONTROL” inputs are selected. Repeat again for ports 3 and 4, then 4 and 5, and so on, ending with ports 11 and 12.

Performance Test Record

NOTE The following pages (Performance Test Record) are designed to be duplicated and used as a template for all of the input ports during each of the performance tests (Insertion Loss, Return Loss, and Isolation). At the top of each page, circle the appropriate input port (A or B) and number (1-4), and write in the test date.

Agilent 87050A Option K22 Test Record

Test Facility _____ Report Number _____

_____ Date _____

_____ Date of Last System Calibration _____

_____

Tested by _____ Customer _____

Model _____ Serial Number _____

Ambient Temperature _____°C Relative Humidity _____%

Test Equipment Used	Model Number	Trace Number	Cal Due Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Special Notes:

_____

_____

_____

_____

_____

A / B i/p Port 1 2 3 4 **Date** _____

Table 6 Agilent 87050A Option K22 Insertion Loss Test Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Insertion Loss to Band 1				
0.5 GHz to 6.0 GHz	Port 1	–2.5 dB	_____	±0.3 dB
	Port 2	–2.5 dB	_____	±0.3 dB
	Port 3	–2.5 dB	_____	±0.3 dB
	Port 4	–2.5 dB	_____	±0.3 dB
	Port 5	–2.5 dB	_____	±0.3 dB
	Port 6	–2.5 dB	_____	±0.3 dB
	Port 7	–2.5 dB	_____	±0.3 dB
	Port 8	–2.5 dB	_____	±0.3 dB
	Port 9	–2.5 dB	_____	±0.3 dB
	Port 10	–2.5 dB	_____	±0.3 dB
	Port 11	–2.5 dB	_____	±0.3 dB
	Port 12	–2.5 dB	_____	±0.3 dB
	AUX	–2.5 dB	_____	±0.3 dB
Insertion Loss to Band 2				
6.0 GHz to 12.4 GHz	Port 1	–3.5 dB	_____	±0.3 dB
	Port 2	–3.5 dB	_____	±0.3 dB
	Port 3	–3.5 dB	_____	±0.3 dB
	Port 4	–3.5 dB	_____	±0.3 dB
	Port 5	–3.5 dB	_____	±0.3 dB
	Port 6	–3.5 dB	_____	±0.3 dB
	Port 7	–3.5 dB	_____	±0.3 dB
	Port 8	–3.5 dB	_____	±0.3 dB
	Port 9	–3.5 dB	_____	±0.3 dB
	Port 10	–3.5 dB	_____	±0.3 dB
	Port 11	–3.5 dB	_____	±0.3 dB
	Port 12	–3.5 dB	_____	±0.3 dB
	AUX	–3.5 dB	_____	±0.3 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 7 Agilent 87050A Option K22 Insertion Loss Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Insertion Loss to Band 3				
12.4 GHz to 20 GHz	Port 1	–4.5 dB	_____	±0.3 dB
	Port 2	–4.5 dB	_____	±0.3 dB
	Port 3	–4.5 dB	_____	±0.3 dB
	Port 4	–4.5 dB	_____	±0.3 dB
	Port 5	–4.5 dB	_____	±0.3 dB
	Port 6	–4.5 dB	_____	±0.3 dB
	Port 7	–4.5 dB	_____	±0.3 dB
	Port 8	–4.5 dB	_____	±0.3 dB
	Port 9	–4.5 dB	_____	±0.3 dB
	Port 10	–4.5 dB	_____	±0.3 dB
	Port 11	–4.5 dB	_____	±0.3 dB
	Port 12	–4.5 dB	_____	±0.3 dB
	AUX	–4.5 dB	_____	±0.3 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 8 Agilent 87050A Option K22 Return Loss Test Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Return Loss Band 1				
0.5 GHz to 1.3 GHz	Port 1	–24 dB	_____	±1.5 dB
	Port 2	–24 dB	_____	±1.5 dB
	Port 3	–24 dB	_____	±1.5 dB
	Port 4	–24 dB	_____	±1.5 dB
	Port 5	–24 dB	_____	±1.5 dB
	Port 6	–24 dB	_____	±1.5 dB
	Port 7	–24 dB	_____	±1.5 dB
	Port 8	–24 dB	_____	±1.5 dB
	Port 9	–24 dB	_____	±1.5 dB
	Port 10	–24 dB	_____	±1.5 dB
	Port 11	–24 dB	_____	±1.5 dB
	Port 12	–24 dB	_____	±1.5 dB
	AUX	–24 dB	_____	±1.5 dB
Return Loss Band 2				
1.3 GHz to 3.0 GHz	Port 1	–20 dB	_____	±1.5 dB
	Port 2	–20 dB	_____	±1.5 dB
	Port 3	–20 dB	_____	±1.5 dB
	Port 4	–20 dB	_____	±1.5 dB
	Port 5	–20 dB	_____	±1.5 dB
	Port 6	–20 dB	_____	±1.5 dB
	Port 7	–20 dB	_____	±1.5 dB
	Port 8	–20 dB	_____	±1.5 dB
	Port 9	–20 dB	_____	±1.5 dB
	Port 10	–20 dB	_____	±1.5 dB
	Port 11	–20 dB	_____	±1.5 dB
	Port 12	–20 dB	_____	±1.5 dB
	AUX	–20 dB	_____	±1.5 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 9 Agilent 87050A Option K22 Return Loss Test Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Return Loss Band 3				
3.0 GHz to 6.0 GHz	Port 1	–14 dB	_____	±0.6 dB
	Port 2	–14 dB	_____	±0.6 dB
	Port 3	–14 dB	_____	±0.6 dB
	Port 4	–14 dB	_____	±0.6 dB
	Port 5	–14 dB	_____	±0.6 dB
	Port 6	–14 dB	_____	±0.6 dB
	Port 7	–14 dB	_____	±0.6 dB
	Port 8	–14 dB	_____	±0.6 dB
	Port 9	–14 dB	_____	±0.6 dB
	Port 10	–14 dB	_____	±0.6 dB
	Port 11	–14 dB	_____	±0.6 dB
	Port 12	–14 dB	_____	±0.6 dB
	AUX	–14 dB	_____	±0.6 dB
Return Loss Band 4				
6.0 GHz to 12.4 GHz	Port 1	–10 dB	_____	±0.5 dB
	Port 2	–10 dB	_____	±0.5 dB
	Port 3	–10 dB	_____	±0.5 dB
	Port 4	–10 dB	_____	±0.5 dB
	Port 5	–10 dB	_____	±0.5 dB
	Port 6	–10 dB	_____	±0.5 dB
	Port 7	–10 dB	_____	±0.5 dB
	Port 8	–10 dB	_____	±0.5 dB
	Port 9	–10 dB	_____	±0.5 dB
	Port 10	–10 dB	_____	±0.5 dB
	Port 11	–10 dB	_____	±0.5 dB
	Port 12	–10 dB	_____	±0.5 dB
	AUX	–10 dB	_____	±0.5 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 10 Agilent 87050A Option K22 Return Loss Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Return Loss Band 5				
12.4 GHz to 20 GHz	Port 1	–8 dB	_____	±0.5 dB
	Port 2	–8 dB	_____	±0.5 dB
	Port 3	–8 dB	_____	±0.5 dB
	Port 4	–8 dB	_____	±0.5 dB
	Port 5	–8 dB	_____	±0.5 dB
	Port 6	–8 dB	_____	±0.5 dB
	Port 7	–8 dB	_____	±0.5 dB
	Port 8	–8 dB	_____	±0.5 dB
	Port 9	–8 dB	_____	±0.5 dB
	Port 10	–8 dB	_____	±0.5 dB
	Port 11	–8 dB	_____	±0.5 dB
	Port 12	–8 dB	_____	±0.5 dB
	AUX	–8 dB	_____	±0.5 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 11 Agilent 87050A Option K22 Isolation Test Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Isolation Band 1				
0.5 GHz to 1.3 GHz	Port 1	–85 dB	_____	±5 dB
	Port 2	–85 dB	_____	±5 dB
	Port 3	–85 dB	_____	±5 dB
	Port 4	–85 dB	_____	±5 dB
	Port 5	–85 dB	_____	±5 dB
	Port 6	–85 dB	_____	±5 dB
	Port 7	–85 dB	_____	±5 dB
	Port 8	–85 dB	_____	±5 dB
	Port 9	–85 dB	_____	±5 dB
	Port 10	–85 dB	_____	±5 dB
	Port 11	–85 dB	_____	±5 dB
	Port 12	–85 dB	_____	±5 dB
	AUX	–85 dB	_____	±5 dB
Isolation Band 2				
1.3 GHz to 3.0 GHz	Port 1	–100 dB	_____	±5 dB
	Port 2	–100 dB	_____	±5 dB
	Port 3	–100 dB	_____	±5 dB
	Port 4	–100 dB	_____	±5 dB
	Port 5	–100 dB	_____	±5 dB
	Port 6	–100 dB	_____	±5 dB
	Port 7	–100 dB	_____	±5 dB
	Port 8	–100 dB	_____	±5 dB
	Port 9	–100 dB	_____	±5 dB
	Port 10	–100 dB	_____	±5 dB
	Port 11	–100 dB	_____	±5 dB
	Port 12	–100 dB	_____	±5 dB
	AUX	–100 dB	_____	±5 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 12 Agilent 87050A Option K22 Isolation Test Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Isolation Band 3				
3.0 GHz to 6.0 GHz	Port 1	–95 dB	_____	±5 dB
	Port 2	–95 dB	_____	±5 dB
	Port 3	–95 dB	_____	±5 dB
	Port 4	–95 dB	_____	±5 dB
	Port 5	–95 dB	_____	±5 dB
	Port 6	–95 dB	_____	±5 dB
	Port 7	–95 dB	_____	±5 dB
	Port 8	–95 dB	_____	±5 dB
	Port 9	–95 dB	_____	±5 dB
	Port 10	–95 dB	_____	±5 dB
	Port 11	–95 dB	_____	±5 dB
	Port 12	–95 dB	_____	±5 dB
	AUX	–95 dB	_____	±5 dB
Isolation Band 4				
6.0 GHz to 12.4 GHz	Port 1	–90 dB	_____	±7 dB
	Port 2	–90 dB	_____	±7 dB
	Port 3	–90 dB	_____	±7 dB
	Port 4	–90 dB	_____	±7 dB
	Port 5	–90 dB	_____	±7 dB
	Port 6	–90 dB	_____	±7 dB
	Port 7	–90 dB	_____	±7 dB
	Port 8	–90 dB	_____	±7 dB
	Port 9	–90 dB	_____	±7 dB
	Port 10	–90 dB	_____	±7 dB
	Port 11	–90 dB	_____	±7 dB
	Port 12	–90 dB	_____	±7 dB
	AUX	–90 dB	_____	±7 dB

A / B i/p Port 1 2 3 4 **Date** _____

Table 13 Agilent 87050A Option K22 Isolation Record

Test Description	Port	Minimum Specifications	Measured Results	Measured Uncertainty
Isolation Band 5				
12.4 GHz to 20 GHz	Port 1	–90 dB	_____	±7 dB
	Port 2	–90 dB	_____	±7 dB
	Port 3	–90 dB	_____	±7 dB
	Port 4	–90 dB	_____	±7 dB
	Port 5	–90 dB	_____	±7 dB
	Port 6	–90 dB	_____	±7 dB
	Port 7	–90 dB	_____	±7 dB
	Port 8	–90 dB	_____	±7 dB
	Port 9	–90 dB	_____	±7 dB
	Port 10	–90 dB	_____	±7 dB
	Port 11	–90 dB	_____	±7 dB
	Port 12	–90 dB	_____	±7 dB
	AUX	–90 dB	_____	±7 dB

Adjustments

There are no adjustments for the test set.

Assembly Replacement and Post-Repair Procedures

The following table contains the list of replaceable parts for the 87050A Option K22 test set. If any of these parts or assemblies are replaced, you must perform all performance tests to verify conformance to specifications.

Table 14 Replaceable Parts

Replacement Part	Agilent Part Number	Qty
smm3.0 25 cwpntx	0515-0667	4
Power Supply	0950-2252	1
Shield	5002-4017	1
Side Cover	5002-3985	2
Cover, Bottom	5002-1088	1
Cover, Top	5002-1047	1
Rear Frame	5021-5806	1
Strut, Side	5021-5837	2
Front Frame	5022-1189	1
FR Cap Strap Hdl	5041-9186	2
RR Cap Strap Hdl	5041-9187	2
Handle Strap	5063-9210	2
Coax Term 3.5M	00909-60007	2
Switch Assembly	08711-60129	1
Rear Panel	08720-00102	1
Switch Bracket	08720-00103	2
RF Cable, Port 1-R	08720-20186	2
RF Cable, Port 2-R	08720-20187	2
RF Cable, Port 3-R	08720-20188	2
RF Cable, Port 4-R	08720-20189	2
RF Cable, Port 5-R	08720-20191	2
RF Cable, Port 6-R	08720-20192	2
RF Cable, Port 1-T	08720-20193	2
RF Cable, Port 2-T	08720-20194	2

Table 14 Replaceable Parts

Replacement Part	Agilent Part Number	Qty
RF Cable, Port 3-T	08720-20195	2
RF Cable, Port 4-T	08720-20196	2
RF Cable, Port 5-T	08720-20197	2
RF Cable, Port 6-T	08720-20198	2
RF Cable, RT1-6	08720-20204	2
RF Cable, RT7-12	08720-20205	2
RF Cable, A i/p 1	08720-20225	1
RF Cable, A i/p 2	08720-20226	1
RF Cable, A i/p 3	08720-20227	1
RF Cable, A i/p 4	08720-20228	1
RF Cable, B i/p 1	08720-20229	1
RF Cable, B i/p 2	08720-20230	1
RF Cable, B i/p 3	08720-20231	1
RF Cable, B i/p 4	08720-20232	1
RF Cable, AUX1	08720-20233	1
RF Cable, AUX2	08720-20234	1
RF Cable, Odd Ports	08720-20235	6
RF Cable, Even Ports	08720-20236	6
RF Cable, AB/RT	08720-20242	2
Wire Harness, Multi-Port	08720-60191	1
Display Subassembly	08720-60193	1
Switch, 1P2T	33314-60012	12
Bracket, Fan	87050-00005	1
Switch Support	87050-00020	1
Deck	87050-00021	1
Fan Assembly, 5 cfm	87050-60027	1
Switch Driver, Daughter Board	87050-60050	1
Controller, Mother Board	87050-60175	1
Front Panel Subassembly	87050-60180	1

Table 14 Replaceable Parts

Replacement Part	Agilent Part Number	Qty
User's and Service Guide	87050-90105	1
Switch, 1P4T	87104-60001	2
Switch, 1P6T	87106-60009	4
Cable Assembly, ac Line	87130-60007	1

NOTE The above parts are unique to this special option. To order replacement parts, please contact the Component Test PGU Support Group at (707) 577-6802 with the part number, module/model number and option number. If ordering parts through your local Agilent Technologies Sales and Service Office, specify that they are ordered through the Component Test PGU Support Group.

NOTE Special options are built to order, therefore long lead times may be encountered when ordering replacement parts.

WARNING **Some parts in the instrument have sharp edges. Work carefully to avoid injury.**

CAUTION Before replacing an assembly or board, inspect for obvious, easy-to-fix defects such as bent pins on ICs or cold solder joints.

Troubleshooting and Block Diagram

This section contains information on troubleshooting the test set to assembly level only. Following these procedures should enable you to determine whether the power supply, front panel, or main switch board need replacing. A block diagram is included at the end of this section as an aid in troubleshooting.

Theory of operation information can be found in the next section of this manual.

General Troubleshooting Notes

WARNING	**Always turn the instrument power off before removing or installing an assembly.**

CAUTION	If you need to disassemble the instrument, be sure to work at an antistatic workstation and use a grounded wrist strap to prevent damage from electrostatic discharge (ESD).

Power Supply Problems

Turn the instrument on. Verify the condition of the LCD on the front panel:

- If it is off, there is still a possibility that the power supply is not supplying the necessary +24V, +12V, and +5V to the main board.
- If the LCD is off, check the main fuse located in the power supply filter at the rear of the instrument.
- If the LCD is still off, check the cable between the main board and front panel board.
- Finally, disconnect the DC power cable from the power supply to the main switch board and measure the voltages. They should be +15V, +12V, and +5V. If not, replace the power supply.

Front Panel Board

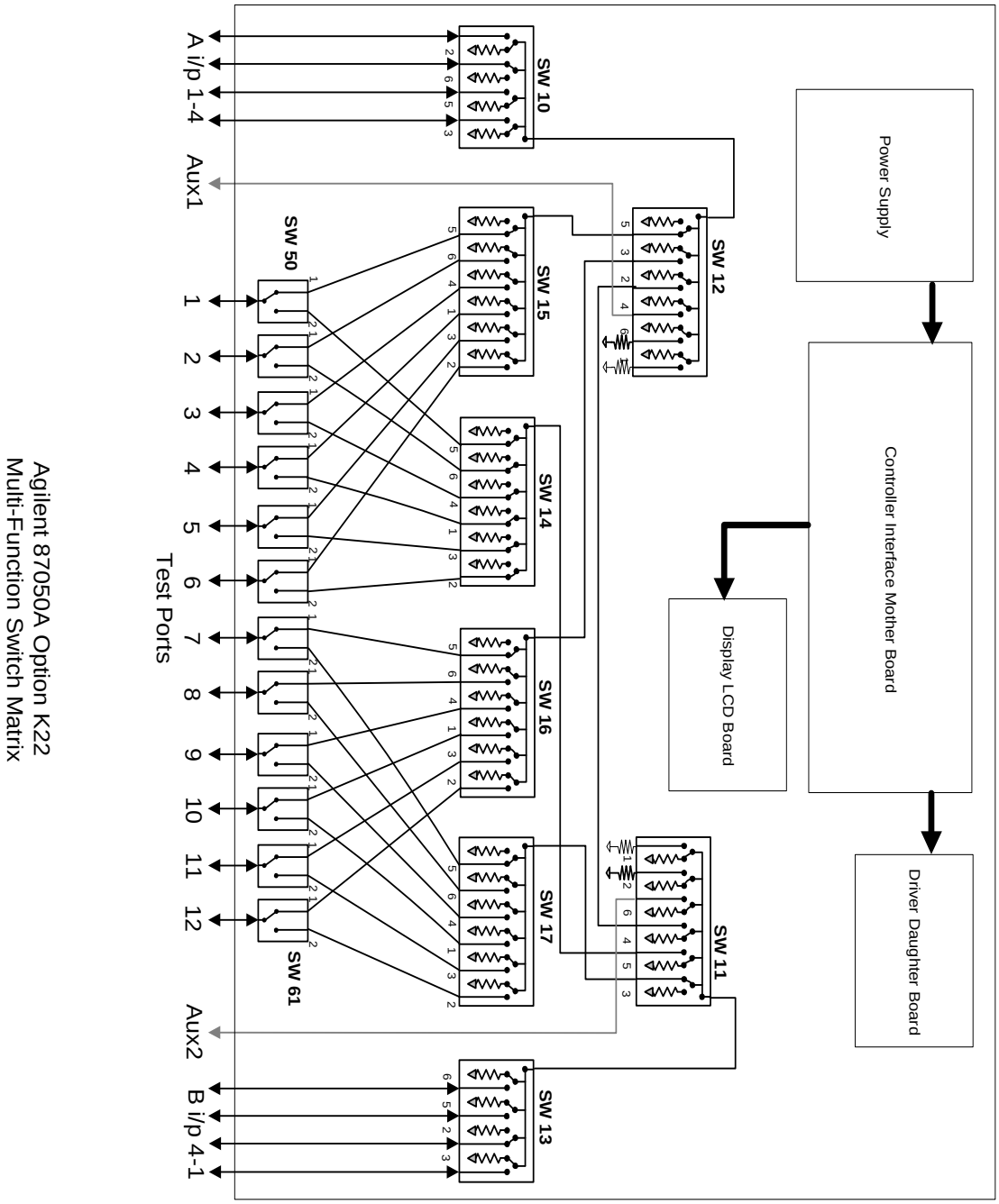
Turn the instrument power on and verify the following:

- Verify the condition of each of the switching paths by issuing commands to switch each of the paths to either the transmission or reflection path. Ensure that the LCD indicates the appropriate path.
- If the LCD indicates a wrong path, the problem can lie with either the front panel board or the main switch board. Measure the RF path to determine where the problem is.
- Ensure that the front panel washers between the board and front panel assembly are present. Missing washers can cause erratic LCD behavior.
- If the LCD does not display the proper path, verify that the RF path has indeed been switched. If the problem lies with the front panel board, replace it.

Controller and Switch Driver Boards

Turn the instrument power on. Verify the condition of each of the switching paths by issuing commands to switch each of the paths to either the A i/p 2 or B i/p 2 path. Verify each of the RF paths for connection. If an RF path is not connected to the necessary port or terminated in 50 Ω, replace the controller and switch driver board.

Figure 16 87050A Option K22 Block Diagram



Agilent 87050A Option K22
Multi-Function Switch Matrix

Theory of Operation

The theory of operation begins with a general description of the Agilent 87050A Option K22 multiport test set. This is followed by more detailed operating theory. The operation of each group is described briefly, to the assembly level only. Detailed component-level circuit theory is not provided.

System Theory

The test set consists of three main components: a power supply, front panel display, and main switch board. The purpose of the power supply is to supply power to both the front panel display and the main switch board. The front panel display serves to indicate the switching paths to the user. Finally, the main switch board does the actual switching between the different ports.

A1 Power Supply Theory

The switching power supply provides regulated dc voltages to power all assemblies in the test set. A dc cable provides power to the main switch board. A connector from the main switch board to the front panel display provides dc power and control signals to the front panel. The power supply provides the following supplies: +5V, +24V, +12V.

The power LED on the front panel indicates that the instrument is on and that the power supply is providing power.

A2 Front Panel Display Theory

The front panel display consists of an LCD. The LCD is divided into two lines, forward and reverse. The first line indicates which of the twelve ports are connected to the forward path. The second line indicates which of the twelve ports are connected to the reverse path. Control signals and DC power are provided via a cable connected to the main switch board.

A3 Controller (Mother Board) and Switch Driver (Daughter Board) Board Theory

Refer to Figure 16 on page 65 for the following discussion.

The mother and daughter boards provide the bias for the switching paths for the various ports to the A i/p or B i/p ports. The front panel display contains an LCD that indicates the switched ports. A particular test port (1 through 12) can be in one of three states. The three states are:

1. Switched to the forward path
2. Switched to the reverse path
3. Terminated in 50 Ω

When a port is not connected, it is automatically terminated in 50 Ω. Only one test port can be connected to any one of the A i/p ports and only one test port can be connected to any one of the B i/p ports at any given time.

The test set consists of twelve 1×2 switches, six 1×6 switches, and two 1×4 switches. The 1×2 switches divide each of the input ports (1 through 12) into two separate paths. One of these paths is open and the other is separated into either the A i/p path or B i/p path.

Two 1×6 switches combine each of the other four 1×6 switches into four banks. These four banks are divided into two for the forward path ports and two for the reverse path ports. Finally, the two 1×4 switches recombine the four banks into either the A i/p port or B i/p port paths.

All switches are mechanical and are biased according to the necessary switching path. A user interface through the GPIB and parallel ports converts the necessary input signals from the user to the necessary control signals to control the switching paths.

Connector Replacement

The 50 Ω 3.5 mm connectors are available separately as part number 5062-6618. It is possible to replace them in the field. A possible alternative to repairing a damaged connector would be just to replace the center pin components. The components are:

Component	**Agilent Part Number**
3.5 mm Connector RF (complete)	5062-6618
3.5 mm Pin and Bead Assembly (only)	5061-5394

When replacing just the pin and bead, a liquid thread-locking adhesive such as part number 0470-1590 will be needed. Re-use any shims and spacers from the connector being replaced. For best results, use a connector gauge to verify pin depth. See Figure 13 on page 44 for proper pin-depth. Add or subtract spacers as required. Spacers and shims are also available from Agilent Technologies.

Safety and Regulatory Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Before Applying Power

Verify that the premises electrical supply is within the range of the instrument. The instrument has an autoranging power supply.

WARNING **To prevent electrical shock, disconnect the Agilent Technologies 87050A Option K22 from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

Connector Care and Cleaning

If alcohol is used to clean the connectors, the power cord to the instrument must be removed. All cleaning should take place in a well ventilated area. Allow adequate time for the fumes to disperse and moist alcohol to evaporate prior to energizing the instrument.

WARNING **Keep isopropyl alcohol away from heat, sparks, and flame. Store in a tightly closed container. It is extremely flammable. In case of fire, use alcohol foam, dry chemical, or carbon dioxide; water may be ineffective.**

Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Agilent Technologies web site at
http://regulations.corporate.agilent.com/DoC/search.htm

Statement of Compliance

This instrument has been designed and tested in accordance with CAN/CSA 22.2 No. 61010-1-04, UL Std No. 61010-1 (Second Edition), and IEC 61010-1 (Second Edition).

General Safety Considerations

Cautions

Cautions applicable to this instrument.

CAUTION	The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

CAUTION	Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

CAUTION	This product is designed for use in Installation Category II and Pollution Degree 2.

CAUTION	Verify that the premise electrical voltage supply is within the range specified on the instrument.

CAUTION	Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

Warnings

Warnings applicable to this instrument.

WARNING	**Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**

WARNING	**This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the product is likely to make the product dangerous. Intentional interruption is prohibited.**

WARNING	**For continued protection against fire hazard replace line fuse only with same type and rating. The use of other fuses or material is prohibited.**

WARNING	**These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.**

WARNING	**The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.**

WARNING	**This product is designed for use in Installation Category II and Pollution Degree 2.**

WARNING	**No operator serviceable parts inside. Refer servicing to qualified personnel.**

WARNING	**If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instrument Markings

The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.

This symbol indicates that the instrument requires alternating current (ac) input.

This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).

This symbol indicates that the power line switch is ON.

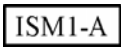
This symbol indicates that the power line switch is in the STANDBY position.

This symbol indicates that the power line switch is in the OFF position.

This symbol is used to identify a terminal which is internally connected to the product frame or chassis.

The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)

The CSA mark is a registered trademark of the CSA International. This instrument complies with Canada: CSA 22.2 No. 61010-1-04.



This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).

Direct Current.

The instrument has been designed to meet the requirements of IP 2 0 for egress and operational environment.

This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

China RoHS regulations include requirements related to packaging, and require compliance to China standard GB18455-2001.

This symbol indicates compliance with the China RoHS regulations for paper/fiberboard packaging.

Battery Collection

Do not throw batteries away but collect as small chemical waste, or in accordance with your country's requirements. You may return the battery to Agilent Technologies for disposal. Refer to "Contacting Agilent" on page 74 for assistance.

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung-3. GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission	
LpA<70 dB	Lpa<70 dB
Operator Position	am Arbeitsplatz
Normal Operation	normaler Betrieb
per ISO 7779	nach DIN 45635 t. 19

EMC Information

Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB du Canada.

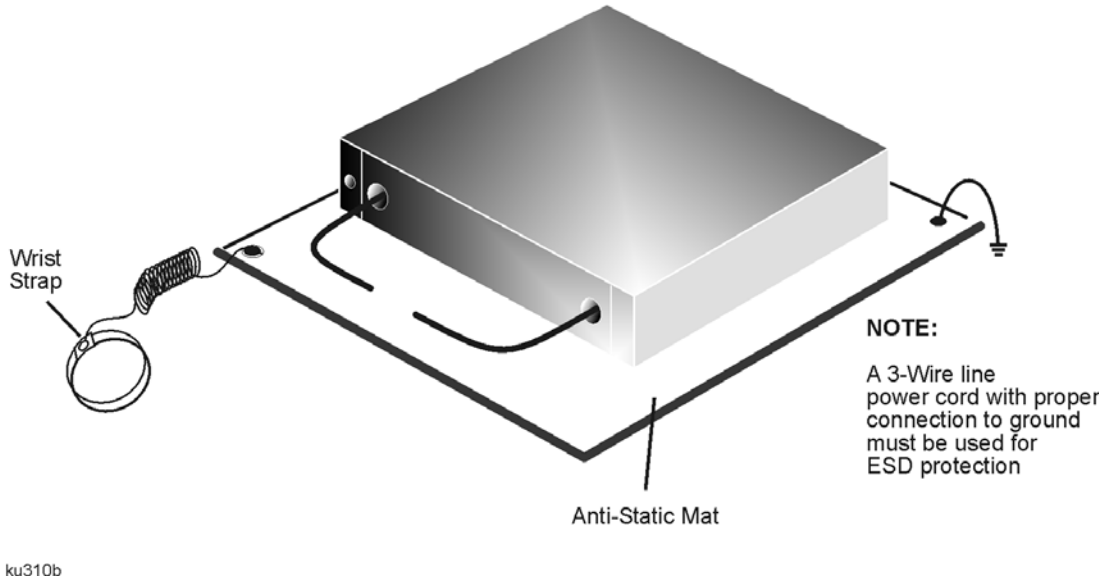
Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the network analyzer. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat (9300-0797) in front of your test equipment.
- *always* wear a grounded wrist strap (9300-1367) with grounding cord (9300-0980), connected to a grounded conductive table mat, having a 1 MΩ resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap (9300-1126) when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:

  1. Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.
  2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
  3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 17 ESD Protection Setup



Agilent Support, Services, and Assistance

Service and Support Options

The analyzer's standard warranty is a one-year return to Agilent Technologies service warranty.

NOTE There are many other repair and calibration options available from the Agilent Technologies support organization. These options cover a range of service agreements with varying response times. Contact Agilent for additional information on available service agreements for this product.

Contacting Agilent

Assistance with test and measurements needs and information or finding a local Agilent office are available on the Web at:
http://www.agilent.com/find/assist

You can also purchase accessories or documentation items on the Internet at:
http://www.agilent.com/find

If you do not have access to the Internet, contact your field engineer.

NOTE In any correspondence or telephone conversation, refer to the Agilent product by its model number and full serial number. With this information, the Agilent representative can determine the warranty status of your unit.

Shipping Your Analyzer to Agilent for Service or Repair

IMPORTANT Agilent Technologies reserves the right to reformat or replace the internal hard disk drive in your analyzer as part of its repair. This will erase all user information stored on the hard disk. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's hard disk before shipping it to Agilent for repair.

If you wish to send your instrument to Agilent Technologies for service or repair:

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Agilent for instructions on where to ship your analyzer.